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Annual Report to the Congress
on
the Administration of the Radiation Control for Health and Safety Act of 1968
Public Law 90-602

April 1, 1970

bureau of radiological health

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
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97

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1969
Annual Report to the Congress on the Administration of the Radiation Control for Health and Safety Act of 1968
Public Law 90-602

April 1, 1970

(Including the Report on Studies Conducted Pursuant to
Section 357, P. L. 90-602)

BRH
bureau of radiological health

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Environmental Health Service
Bureau of Radiological Health
Rockville, Maryland, 20852

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ANNUAL REPORT ON THE ADMINISTRATION OF THE RADIOLOGICAL CONTROL FOR HEALTH AND SAFETY ACT OF 1968

I. INTRODUCTION AND SUMMARY

This report covers calendar year 1969 activities of the Department of Health, Education, and Welfare in administering the Radiation Control for Health and Safety Act (Public Law 90–602). The delegation of authority to the Bureau of Radiological Health for administration of the Act was published in the Federal Register on June 4, 1969. The Secretary of Health, Education, and Welfare is required by Section 360D of the Act to submit an annual report to the President for transmittal to the Congress on or before April 1.[1]

Investigations have been made of the existing scientific evidence, including genetic effects, resulting from exposure to electronic product radiation in the fields of ionizing radiation, ultraviolet light, visible light, infrared, microwaves, radiofrequency radiation, lasers, infrasonics, sonics, ultrasonics, and magnetics.

The Performance Standard for Television Receivers, promulgated on December 25, 1969 (Federal Register, Volume 34, Number 247), is applicable to television receivers manufactured after January 15, 1970. A proposed performance standard for microwave ovens was prepared for consideration by the Technical Electronic Products Radiation Safety Standards Committee. The Department has developed a performance standard for demonstration-type gas discharge tubes and is preparing it as a notice of proposed rulemaking. A standard for diagnostic x-ray apparatus used in the healing arts is in the early stages of development.

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[1] Activities herein reported were carried out by the Bureau of Radiological Health, Environmental Health Service, Department of Health, Education, and Welfare. During the calendar year 1969, the Bureau of Radiological Health was a component of the Consumer Protection and Environmental Health Service.

The Department of Health, Education, and Welfare was involved in certain actions of a voluntary nature in cooperation with State and local radiation control programs, although no enforcement actions, court decisions, or compromises of alleged violations relative to noncompliance with standards occurred. These actions were related to excessive radiation from color television receivers, microwave ovens, and demonstration-type cold cathode gas discharge tubes. In these instances where compliance was voluntary or in one case in which a directive was issued, the individual electronic equipment manufacturers were markedly cooperative.

Some problems of Public Law 90–602 administration were recognized as the result of studies relative to the control of health hazards from electronic product radiation and other types of ionizing radiation. The studies were made by the Department of Health, Education, and Welfare under Section 357 of the Law. Findings of the studies are presented briefly in a portion of this Report which summarizes administration problems.

Technical information was disseminated to the scientific, commercial, and labor community and consumer-oriented information was made available to the public through publication of technical reports, news releases, manuals and technical instructional materials, meetings, conferences, and exhibits. The appendix presents these activities in detail.

The Log of Visits to Public Agencies, Manufacturers' Plants; Consultation with Industry and Public Agencies (in the appendix) demonstrates the cooperation between Government officials and representatives of industry and other interested parties in the implementation of P.L. 90–602.

II. SUBJECT AREAS COVERED BY THIS REPORT

Section 360D of Public Law 90–602 directs that the Annual Report shall cover:

> (1) a thorough appraisal of the incidence of biological injury and effects, including genetic effects, to the population;
>
> (2) a list of Federal electronic product radiation control standards;
>
> (3) an evaluation of the degree of observance of applicable standards;
>
> (4) a summary of outstanding problems in the administration of the Act;

(5) an analysis and evaluation of research activities and technological progress for safety;

(6) a list of completed or pending judicial actions;

(7) the extent to which technical and consumer-oriented information was disseminated; and

(8) the extent of cooperation between Government officials and representatives of industry and other interested parties.

The Report shall contain such recommendations for additional legislation as the Secretary deems necessary to promote cooperation among the several States in the improvement of electronic product radiation control and to strengthen the national electronic product radiation control program.

III. REPORT BY SUBJECT AREA APPRAISAL OF INCIDENCE OF BIOLOGICAL INJURY AND EFFECTS

Requirement (1)

SEC. 360D. (a) (1) a thorough appraisal (including statistical analysis, estimates, and long-term projections) of the incidence of biological injury and effects, including genetic effects, to the population resulting from exposure to electronic product radiation, with a breakdown, insofar as practicable, among the various sources of such radiation.

Action

A thorough appraisal of the frequency of biological injury arising from electronic product radiation cannot be provided at this time. In many instances, this requires a long-term commitment to conducting both epidemiologic studies of human populations and supportive animal studies. The fact that there is no unique consequence following exposure to radiation complicates further the difficulty of establishing the extent of biological injury to human populations. The delayed effects of radiation will continue to be difficult to evaluate. There is still much definitive work to be done in ionizing radiation and even more in the newer problem area of nonionizing radiation. Ionizing radiation is defined as any electromagnetic or particulate radiation capable of producing ions, directly or indirectly, in its passage through matter. The Radiation Incidents Registry, recently established by the Department of Health, Education, and Welfare (described later in this Report) should provide information that will add significantly to our knowledge of the effects of accidental radiation exposures.

Studies of the effects of ionizing radiation resulting from sources other than electronic products are included here, since any knowledge of ionizing radiation effects helps in evaluating hazards and yields information of relevance to the areas of concern under P.L. 90–602. For example, co-insult studies have demonstrated the enhancement of virus infection of cells exposed to ionizing radiation (*1*). Preliminary bioeffect research studies have demonstrated that microwaves can induce chromosome abnormalities and alter protein synthesis (*2,3*). These studies are discussed in more detail on page 28.

The populations of Hiroshima and Nagasaki, for example, present a unique opportunity to study the long-term effects of a single external whole-body exposure to ionizing radiation. During 1969 long-term studies were continued in mortality, cytogenetics, leukemia, thyroid disorders, carcinogenesis, and other areas. The Department has participated in this program since 1956 through the assignment of medical officers to the Atomic Bomb Casualty Commission in Japan. The Atomic Bomb Casualty Commission was established in 1947 at the request of the President of the United States to conduct long-term studies of delayed effects on the survivors of the atomic bombs detonated over Hiroshima and Nagasaki. The Atomic Bomb Casualty Commission is now a cooperative research agency of the U.S. National Academy of Sciences–National Research Council–and the Japanese National Institute of Health of the Ministry of Health and Welfare.

Data collected on the Cooperative Thyrotoxicosis Followup Study on 36,000 patients (completed this year) investigated the incidence of leukemia and other diseases following therapeutic administration of iodine 131 for thyrotoxicosis (*4*). To date, the data show no significant increase in the patient risk for leukemia following iodine 131 therapy.

A national electronic products inventory study has provided a general indication of the possible extent of population exposure from both ionizing and nonionizing radiation sources (*5*). A partial list of national inventory estimates of ionizing radiation sources as of January 1970 is given in table 1.

In order to be responsive to the requirement stated in Public Law 90–602 and to provide an appraisal of the incidence of biological injury resulting from exposure to electronic product radiation, the Department has developed a new Radiation Incidents

TABLE 1. *Estimated national inventory of ionizing radiation sources, January 1970*

Product	Estimated number
Color television (households)	24,000,000
Medical x ray	115,000
Dental x ray	100,000
Industrial x ray	15,000
Accelerators	1,200
Electron microscopes	500

Registry (RIR) under authority of the Radiation Control for Health and Safety Act of 1968 (42 U.S.C. 263b et seq.). A description of the registry and its purpose will be provided to about 2,000 Federal, State, and local health agencies. Any incident involving electronic product radiation will be reported to the Registry by a reporting agency or individual. An incident report will include (1) circumstances surrounding the incident, (2) type of radiation and the estimated exposure, (3) personal data on the exposed person, and (4) medical treatment given. Data accumulated in the Registry will be disseminated through Department and State network channels. The Registry will be used to identify radiation sources posing the greatest risks and to establish priorities for corrective action. Data from the Registry will be studied for indications of population groups that would promise reasonable returns from studies of long-term somatic and genetic effects.

X rays

In 1969, a scientist received an estimated dose of 1,700 rem to the fingers of his left hand, 50 rem to his right eye, and 2,400 rem to the skin of his upper left arm when he was accidentally exposed to 8-KeV x rays from the primary beam of an x-ray diffraction unit while he was in the process of making some physical measurements. Because of the variable nature of the operations being performed by the individual, it was not possible to determine accurately the times of exposure and exact locations of surfaces in the x-ray beam. Skin dose to a portion of the left hand could have been as much as a factor of 20 higher or a factor of 2 lower than that given, and the dose to the skin of the upper arm and right eye could have been a factor of 2 higher or lower; however, the lack of clinical signs on skin surfaces other than the left hand, as of November 1969, indicates a probable dose to the upper arm of less than 1,500 rem. Because of the low energy of the x rays and the limited area exposed, the dose to the blood-forming organs and gonads was less than 100 millirem.

The finding of increased risk of thyroid neoplasia in children treated for thymus enlargement with x rays led to a concern about the possible long-term effects to the thyroid gland of children exposed to diagnostic levels of radioiodine. Plans have been initiated for a followup study to investigate the incidence of thyroid neoplasia in children who have received diagnostic doses of iodine 131.

A final report was issued on population doses resulting from medical and dental x rays, based on the Public Health Service X-ray Exposure Study initiated in 1964 (*6*). These data provide, for the first time, national estimates of gonad and genetically significant dose to the U.S. population resulting from medical and dental sources.

The genetically significant dose is defined as the gonad dose that, if received by every member of the population, would result in the same total genetic effect to the population as the doses that are actually received by individuals within the population. The genetically significant dose for the U.S. population (1964) was estimated to be 55 millirads per person per year. This value is higher than that for other countries.

The contribution to the genetically significant dose from radiography was 96 percent, with 4 percent from fluoroscopy and less than 1 percent from photofluoroscopy. The largest single population group contributing to the genetically significant dose was males 15 to 29 years of age.

The Department maintains a Radiation Registry of Physicians as a long-term project to obtain data for a study of possible somatic and genetic effects resulting from long-term exposure to low-level ionizing radiation as a result of their use of x rays in the healing arts. Data are collected and maintained on two groups of physicians, one with relatively high and the other with relatively low-radiation exposure. The morbidity and mortality experience of the radiologists (the high-exposure group) and their families is to be compared with analogous findings for pathologists and their families.

A study is being made on approximately 15,000 children who received scalp x irradiation for treatment of *tinea capitis* (ringworm of the scalp) in order to determine whether there is an association between such irradiation and the later development of nervous and behavioral disorders, mental retardation, and neoplasms. This study is being conducted in Israel using Public Law 83–480 funding.

Through a grant from the Department of Health, Education, and Welfare to the New York University Medical Center, a similar study is being conducted to determine the long-term health experience of approximately 2,404 cases of *tinea capitis* who were treated by x-ray epilation and 1,794 *tinea capitis* cases who did not receive x-ray therapy. Results to date have confirmed 14 cases of cancer in the irradiated group compared to one case in the controls. The incidence of confirmed psychiatric illness was considerably higher in the irradiated group (3.2 percent) compared to the controls (1.27 percent). Dosimetric studies indicated that the average scalp dose was about 800 rads. The dose to the brain ranged from 150 rads at the surface to 50 rads at the base. Doses to the eyes and ears and cranial marrow were 50, 70, and 435 rads, respectively.

Plans have been developed for a study that will identify women of child-bearing age who have had abdominal x-ray exposures. Later contact will determine if they were pregnant at the time of exposure or if they became pregnant shortly after exposure and, if so, the outcome of the pregnancy.

Ultraviolet

The critical organs for ultraviolet exposure are the eyes and skin, and the major observation of cumulative effects of ultraviolet is concerned with the production of skin cancer (*7*). Eye burns have been documented and reported by State Health Departments as a result of exposure to ultraviolet light in the following States: Georgia, nine cases; Mississippi, one case; New Jersey, three cases (*8–10*). Population exposure results from a wide range of apparatus used in homes, industries, places of entertainment, health clubs, and scientific and medical environments. Some typical uses of ultraviolet include cosmetic and therapeutic sun lamps, disinfection, sterilization, and analytical instruments.

Much of the information presented below was derived from detailed reviews of scientific literature. With the exception of microwaves and radiofrequency radiation, population or health effects studies were not conducted by the Department in 1969; nevertheless, inventories of sources of radiation, development and evaluation of survey techniques, and field surveys of users of these devices were carried out.

Visible Light

The penetrating ability of visible light is slight except for transparent materials such as water, glass, and the lens and humors of the eye. Pulsating light at certain frequencies has been reported as a potential source of producing psychological effects. Because of its narrow depth of penetration, visible light in general does not manifest itself as a potential hazard; however, there are situations in which it can become hazardous. Probably the one greatest danger is that of high-intensity light, which may cause transient loss of visual function (flash blindness) or irreversible thermal injury of the retina.

Flash blindness is a relatively new problem to man occurring only since man has developed sources of light brighter than the sun. It results from the bleaching of the visual pigments of the eye. Flash blinding can be prevented with proper filtering of light when the occurrence is expected. Irreversible thermal injury has been known for years; for example, lookouts for airplanes have on occasion suffered retinal lesions which appear to be caused by heat generated at the sun's image on the retina.

Visible light presents little biological hazard per se except to the eye. There appear to be three predominant factors controlling the potential of the hazard to the eye: (1) intensity, (2) pupil dilation (that is, the area of exposure), and (3) length of exposure. If these factors are controlled to keep the absorbed energy below the threshold of thermal burning (reported to be between 40 and 50 calories/cm^2 per minute), no eye injury would be expected.

Infrared

Infrared can produce burns of the skin, cataracts, or retinal burns. The more common industrial exposures to infrared are found in hot metal operations, glassmaking, photoengraving, paint and enamel drying, and welding. Infrared is also used in homes and eating establishments for both heating and cooking purposes. A U.S. Department of Agriculture survey in 1966 estimated that there were 13,400 infrared ovens in food service establishments in the United States.

Microwaves

The first major public scientific meeting on health implications of microwave exposure at which comprehensive reviews of Russian and Eastern European findings were discussed in detail was held in September 1969 under the joint sponsorship of the Medical College of Virginia and the Department. Epidemiological studies were urged to determine the incidence of known microwave effects, such as eye cataracts, as well as the more subtle and reversible effects, including headaches, behavioral changes, and other symptoms reported by Russian and Eastern European scientists.

A partial listing of the estimated national inventory of microwave sources is given as an indication of the possible magnitude of population exposure (table 2). These estimates do not include certain military radar or commercial mobile radar units, such as on planes and ships (*5*). It is of particular public health significance that there is expected to be a substantial increase in the use of microwave devices in consumer, commercial, and industrial applications in the future; for example, the sales of domestic microwave ovens are expected to increase from the present annual sales of about 40,000 to about 200,000 in 1975.

TABLE 2. *Estimated national inventory of microwave sources, January 1970*

Product	Estimated number
Microwave communications transmitters	66,000
Domestic microwave ovens	50,000
Commercial microwave ovens	45,000
Microwave diathermy units	15,000
Radar on pleasure boats	7,500
Stationary radar	5,500
Industrial microwave heating units	300

A study at The Johns Hopkins University (supported by the Department of Health, Education, and Welfare) reported a possible relationship between paternal radar exposure and Downs Syndrome (mongolism) among offspring. The same research group making the initial observations is testing this preliminary finding by enlargement of the study group and collection of detailed exposure history of the fathers of the children in the study.

A small number of men, all of whom spent a portion of their service careers as radar technicians, contacted the staff of the Northeastern Radiological Health Laboratory of the Bureau of Radiological Health in Winchester, Mass. with the common complaint of loss of sight because of various degrees of cataract formation A protocol is being developed to examine these men and reconstruct their microwave exposure histories.

Plans are underway to determine the extent of the use of diathermy in dental practice and the feasibility of locating a study population of sufficient magnitude to evaluate ocular damage that may result possibly from this application of nonionizing radiation. The following report indicates the kind of problem that may arise from diathermy devices.

An individual who received extensive microwave diathermy about the neck and face developed typical microwave radiation cataracts in both eyes. This finding has been reported to the Department. Extensive eye examinations have been conducted by experts at the Northeastern Radiological Health Laboratory and the Massachusetts General Hospital. Other possible etiologies (diabetes, senility, ionizing radiation) have been ruled out. Because of his training and background, this particular individual was able to associate a probable cause and effect. There may be other individuals who have undergone similar treatment and have experienced a loss of vision because of cataract formation. Ophthamologists or practitioners using microwave diathermy often are unaware of the potential hazards and are therefore not alert to possible adverse radiation-related sequelae.

Data from the Malformations Registry of the National Communicable Diseases Center, Atlanta, Ga., are being made available for possible additional studies on the relationship between congenital malformations and exposure to nonionizing radiation.

A "Radiation Exposure Overview on Microwave Ovens and the Public" containing information on the bioeffects of or relating to exposure from microwave ovens, has been published by the Department.

Radiofrequency Radiation

Radiofrequency radiation has been reported as capable of producing some biological effects similar to those attributed to microwave radiation (*11*). A partial listing of the estimated inventory of electronic products emitting radiofrequency radiation is given in table 3 as an indication of the possible magnitude of population exposure.

Consideration is being given to possible exposure studies involving radiofrequency radiation.

TABLE 3. *Estimated inventory of electronic products emiting radiofrequency radiation, January 1970*

Product	Estimated number
Transmitters in safety and special services	6,500,000
Transmitters, commercial and education, AM, FM, and TV	8,000
TV translators and boosters	2,200

Laser

The eye is the critical organ for laser radiation. It is estimated that there are approximately 17,000 laser devices in the United States, excluding an unknown number of inexpensive, simple to construct lasers built from kits.

Bioeffects resulting from exposure to lasers were reported in the "Occupational Health Survey in the Use of Lasers," published by the Public Health Service, January 1969, as TR–63. Surveys conducted on the basis of manufacturers' codes of good practice in cooperation with the State of California resulted in a reported 4 percent of users of lasers exhibiting some retinal injury. Massachusetts' survey reported 2 percent similar damage, and New Jersey reported 2 percent.

Infrasonic

Infrasonic vibrations can cause physical discomfort. Infrasonic vibrations may originate from a variety of mechanical devices as well as from natural sources, such as earthquakes and erupting volcanoes. The majority of sources of infrasound are probably not considered electronic products in the context of P.L. 90–602.

Sonic

Sonic vibrations can cause both physical and emotional effects in humans. Effects, such as deafness, fatigue, and decreased concentration, have been reported. Further, it is estimated that the overall level of sound in the United States is doubling every 10 years. Sources of noise are varied with a great number of them outside the area of responsibility of electronic products.

Ultrasonic

A summary of reported biological effects of ultrasonic vibrations has been prepared by the Department (*12*). An extensive review of the literature on biological effects of ultrasonic vibrations has been prepared under contract with the Massachusetts Institute of Technology.[2]

Ultrasound of diagnostic intensities does not seem hazardous in the hands of the trained technician. Ultrasound of therapeutic intensities (slightly more intense) can be hazardous even in the hands of the trained technician. Cases of injury to tissue at therapeutic levels have been noted. Ultrasound of still higher intensities is a destructive device. It may be used with extreme caution in certain surgical procedures; however, the safety of ultrasound in such procedures cannot be guaranteed in the face of possible minimal damage.

In cases where ultrasound emanates into air, the probability of damage to tissue is lower than in the case of direct contact since poor coupling is obtained between ultrasonic transducers and air. The dangers of airborne hearing damage, systemic effects, and psychological effects necessitate caution even in the case of airborne ultrasound. Such ultrasound may be emitted by machinery not normally intentionally causing airborne ultrasound; thus surveillance in the near environment of the devices may be necessary.

The interactions of ultrasound in tissue have been studied; however, these interactions are amazingly complex, and much further study is needed to understand completely the interactions of ultrasound. Presently, much of the reported ultrasonic damage may be explained in light of existing theory. Further study is needed to explain certain cases.

Magnetic Fields

There are subtle biological effects from exposure to magnetic fields but only after exposure to extremely high levels. From a public health standpoint, the risk of large population groups being exposed to harmful magnetic fields appears relatively small; therefore no specific programs have been initiated in this area.

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[2] Available from the National Technical Information Service, Springfield, Va. 22151, Publication No. 185-963.

IV. LIST OF RADIATION CONTROL STANDARDS

Requirement (2)

SEC. 360D. (a)(2) a list of Federal electronic product radiation control standards prescribed or in effect in such year, with identification of standards newly prescribed during such year.

Action

One electronic product radiation control standard was prescribed under Public Law 90–602 in 1969. This **Performance Standard for Television Receivers,** as promulgated on December 25, 1969 (Federal Register, Volume 34, Number 247), is applicable to television receivers manufactured after January 15, 1970. This standard prescribes and discusses the relevant subjects of certification, labeling, special test procedures as they relate to radiation emission from the receivers, and it establishes specific performance requirements regarding radiation emission, such as an exposure rate limit, measurements, and testing conditions. The standard limits x-ray emissions from sets produced after January 15, 1970 to a maximum of 0.5 milliroentgen per hour 5 centimeters (about 2 inches) from any external surface of the set operating at a maximum of 130 line volts, even though a set owner accidentally should maximize the receiver's x-ray emission potential by maladjusting external controls. High line voltages, irrespective of external control maladjustment, have been found to be a cause of excessive TV set x-ray emissions. Other more stringent requirements are set forth in this standard to become effective on June 1, 1970 and June 1, 1971.

In addition to this standard, the Department promulgated regulations in the Federal Register on June 4, 1969 setting forth **corrective action** to be taken by manufacturers when such electronic products as color television receivers and microwave ovens are found to have a radiation safety defect or fail to comply with a Federal radiation control standard. The regulations establish procedures for notification of the Government when manufacturers detect defects in electronic products and spell out the steps the manufacturer must take to warn distributors and users of such defects and to offer repair, replacement, or cost refunds.

Two classes of electronic products are covered by the definition of safety-related radiation defects: (1) products emitting radiation as part of their function (such as x-ray machines), but which fail to conform to radiation-emission design specifications or which emit radiation beyond levels necessary for their performance and (2) products not utilizing radiation as part of their function (such as television sets), but which emit unintended radiation at levels creating a risk to health or which do not conform to design specifications.

Proposed regulations relating to **recordkeeping reporting requirements** for manufacturers and distributors of certain electronic products were published in the Federal Register December 16, 1969. These requirements would apply to manufacturers of television receivers, television projection devices, shunt regulator tubes, high-voltage rectifier tubes, high-voltage vacuum switches, all types of x-ray producing devices, microwave ovens, microwave diathermy units, all types of lasers, and ultrasonic devices. Records that manufacturers would be required to maintain for 5 years, starting with the first date on which the product was offered for public sale, would include: (1) radiation test results and methods, (2) product durability and stability tests, (3) quality control procedures, and (4) product use, maintenance, and testing instructions that have radiation control significance. Additional requirements, reporting procedures, and required records are described in the regulations.

As required under Section 358 of Public Law 90–602, **a Technical Electronic Product Radiation Safety Standards Committee** has been established. Public Law 90–602 specifies that the Secretary of the Department of Health, Education, and Welfare shall consult with this Committee, composed of 15 members, before prescribing any standard under this section. The membership of this Committee is given in the Appendix.

The Committee (TEPRSSC) met on four occasions in 1969. On June 26–27 general procedures for Committee operation were agreed on and early drafts of the television, microwave ovens, and x-ray performance standards were presented to the Committee for information purposes. During the second meeting on August 12, the Committee recommended for approval the proposed television receiver performance standard. On September 16–17, the Committee recommended for approval a proposed demonstration-type cold cathode gas discharge tube, and further consideration was given to a later draft of a proposed microwave oven performance standard.

On October 31, the Committee recommended for approval the proposed microwave oven standard, except for the section regarding the method of measurements. The Committee advised the Department and the manufacturers to attempt to settle this remaining significant issue with the results being communicated back to the Committee for review.

A standard for **diagnostic x-ray apparatus** used in the healing arts is in the early stages of development.

The Department has assembled standards and recommendations of governmental and nongovernmental organizations for evaluation and interpretation. These will be used as a basis for developing Federal performance standards.

V. EVALUATION OF OBSERVANCE OF APPLICABLE STANDARDS

Requirement (3)

SEC. 360D. (a)(3) an evaluation of the degree of observance of applicable standards, including a list of enforcement actions, court decisions, and compromises of alleged violations by location and company name.

Action

One applicable regulatory standard was promulgated under Public Law 90–602. Since the standard is applicable to television receivers manufactured after January 15, 1970, no enforcement actions, court decisions, or compromises of alleged violations are reported relative to noncompliance with standards; nevertheless, during the past year the Department did involve itself in certain actions of a voluntary nature providing a degree of control of unnecessary radiation exposure. In most cases, these actions were taken using as guidelines State regulations, industry standards and codes of good practice, and/or voluntary standards of national and international standard-setting organizations.

A source of potential microwave radiation exposure to the general population is the **microwave oven**, which consists of a microwave-generating magnetron tube, a waveguide to direct the radiation to the cooking chamber, and a mixer to distribute the radiation throughout the chamber. In 1968, total sales of all types of microwave ovens were projected at about 40,000 units per year.

Microwave ovens will find increasing wider use in the future for the rapid preparation of foods in homes and restaurants.

Several States have participated in cooperative surveys of microwave ovens. These surveys used the industry's "good manufacturing standards" of 10 milliwatts per square centimeter. Approximately one-third of the ovens surveyed emitted radiation in excess of this level; for example, the Department, in cooperation with the Florida State Board of Health, surveyed microwave ovens located in commercial establishments in Florida. Of 34 ovens surveyed, 13 showed maximum power density leakage at a distance of 2 inches with the doors closed or during door opening in excess of 10 mW/cm^2. Eighteen States presently have access to microwave survey instruments and several others have the instrumentation on order.

After testing of a microwave oven in March 1969, the Department found that the oven door interlocks were of an inadequate design. Although all of the ovens of this particular model were manufactured before October 18, 1968, the manufacturer, informed of the findings, voluntarily agreed to initiate a corrective action program. During May 1969, the first purchasers of the ovens were apprised of the situation and notified that a kit was available to correct the interlock condition free of charge.

These surveys of microwave ovens were important in that they showed the problem of microwave oven leakage to be industry-wide and established the basis for the industry—Government decision to make a nationwide survey early in 1970 of microwave ovens in use.

Demonstration-type cold cathode gas discharge tubes are a potential source of harmful rays in science, biology, or chemistry classrooms. These tubes are used to demonstrate physical phenomena such as heating, deflection, fluorescent lighting, kinetic energy, and other electromagnetic characteristics.

As a result of studies by the Department in April 1969, which showed that three types of demonstration-type cold cathode gas discharge tubes were potentially hazardous because of excessive radiation emissions, the Department requested distributors of these tubes to stop the sale of these items and return them to the manufacturer. The Department, in addition, notified all State health and education departments of this potential problem. Subsequent to the Department's investigation, and after a series of communications with the manufacturer, the manufacturer redesigned the three types of cold cathode demonstration tubes to eliminate the hazardous radiation emissions. Two types of redesigned tubes appear to have properly eliminated the radiation, and the manufacture of the third type has been discontinued.

Thirty-five States have initiated action to locate and identify cold cathode tubes used in secondary school systems. At least four States conducted inventory and physical surveys before the joint State–Federal survey in the spring of 1969; in addition, the cities of Philadelphia and New York have completed physical surveys of the cold cathode gas discharge tubes in their school systems. Twenty States have begun physical surveys of radiation sources in their school systems. One State has established guidelines for the school system to follow until the tubes have been surveyed. Five States have also begun an educational approach to control the radiation exposure from the demonstration-type cold cathode gas discharge tubes. This approach ranges from distribution of descriptive information sheets to a proposed 2-day seminar for science instructors and a demonstration being developed for educational television. Many of the State radiological health agencies are working with or through their respective State educational departments, thus developing a method of communication and consultation in the area of radiological health.

Prompt action taken immediately after these surveys by the Department and by State and local health and educational agencies provided health protection for students and teachers with respect to tubes that were produced prior to the effective date of P.L. 90–602, and therefore could not be covered by standards.

A television manufacturer notified the Department on June 20, 1969, that it was modifying over 12,000 color television sets in which an unsatisfactory component had possibly been installed. After consultations with the Department, the manufacturer decided to correct the problem with a replacement component of better design that, according to the manufacturer's data, did not have the tendency to emit radiation at unacceptable levels when tested with all user and service controls set at maximum levels and operated at maximum line voltage. On July 17 and 18, 1969, personnel of the Department visted 12 of the manufacturer's distribution and warehouse locations and verified that the modification program was being carried out as reported by the manufacturer. On August 29, 1969, the manufacturer notified the Department that all sets had been modified, with the exception of 10 that they could not locate.

On July 25, 1969, the Department notified regional radiological health representatives and State health department personnel that an x-ray emission problem had been reported and confirmed on a **television projection system.** These television projection systems are defined as devices used for visual display at political rallies, in classrooms, closed circuit boxing events, and other forms of entertainment. A television projection system of this type has been loaned to the Department and is currently undergoing extensive testing by members of the Department.

It is estimated that there are currently 7,000 to 10,000 units of this type, which have been manufactured and sold to date. The typical selling price is approximately $3,000. Surveys have been conducted on nine different models made by seven manufacturers. Following the completion of laboratory testing and an analysis of the survey data, appropriate recommendations will be prepared by the Department to avoid the possible hazard from excessive radiation from these systems.

After notification by the State of Florida in March 1969 that certain **fluoroscopic x-ray units** were emitting unnecessary radiation, and after further investigation and subsequent communication with Florida, the Department contacted the manufacturer in August 1969 alerting him to the problem. Within 2 weeks the manufacturer took corrective action to resolve the problem by redesigning the device and by retrofitting those units already in use.

Upon request from the Department in June 1969 for information on a **portable industrial x-ray spectograph**, the manufacturer submitted the device to the Department for certain radiation emission tests. The device was found to be emitting excessive levels of radiation, possibly because of two design problems. The manufacturer, subsequently in September 1969, notified the Department that he had solved both problems and would recall all devices (10 in number) for modification and correction of the two problems.

An **x-ray tube housing** manufacturer notified the Department in October 1969, of a potential x-ray leakage problem from a certain tube housing model used in medical x-ray machines. A meeting between the Department and the manufacturer was held to discuss the problem in detail. The manufacturer has submitted a correction program with a time schedule for completion. The manufacturer has had difficulty in obtaining modification components, and the correction program for all machines of that model number (approximately 3,300 machines) will be tentatively initiated on a full-scale basis by March 1970.

VI. SUMMARY OF OUTSTANDING PROBLEMS

Requirement (4)

SEC. 360D. (a)(4) a summary of outstanding problems confronting the administration of this subpart in order of priority.

Action

PRIORITY 1. Control of Health Hazards from Electronic Product Radiation and Other Types of Ionizing Radiation.

Section 357 of Public Law 90–602 requires the Secretary of the Department of Health, Education, and Welfare to conduct certain studies relative to the control of health hazards from electronic product radiation and other types of ionizing radiation and report to the Congress on the results of such studies on or before January 1, 1970, together with such recommendations for legislation as he may deem appropriate. A copy of this Report is attached. A brief summary of the general findings and conclusions is presented here.

A. State Control Capability

Various facets of State control of radiation health hazards have been investigated, including legislation and regulations, compliance, manpower, funds, training, and instrumentation. Although 47 of 53 "States" (including Puerto Rico, the Virgin Islands, and the District of Columbia) have passed legislation to authorize the control of ionizing radiation, only 50 percent of these have adopted most of the provisions of the Council of State Governments' model regulations. Considerable variation was observed among State regulations. Only five States have specific authority to control one or more sources of nonionizing radiation, such as lasers and microwaves. Major inadequacies in a number of State programs include (1) lack of regulations or failure to update regulations to implement radiation control authority; (2) insufficient funds and personnel to conduct comprehensive control programs in the areas of ionizing and nonionizing radiation; (3) no provision to license, certify, or set qualifications for operators of x-ray machines used in the healing arts; and (4) lack of uniformity in the control of health hazards from the use of radium and accelerator-produced radionuclides, including safety standards, inspection requirements, regulations, and enforcement.

B. Federal Control

Federal control has been examined from the aspects of control of health hazards to the general public based on statutory authority to control radiation and control of health hazards to Federal employees and the public from electronic products and certain radioative materials used by the Federal Government. It is concluded that:

(1) Federal statutory authority and responsibility for the control of health hazards to the public from electronic product radiation and certain types of radioactive material is limited to specified occupational situations, radiation uses, locations, or types of radiation. No Federal agency has authority to control the health hazards to the public from the general use of certain radioactive materials, such as radium, that are not controlled by the Atomic Energy Commission. Many States, however, have such authority and conduct control programs.

(2) Although the Federal Government is a major user of electronic products and certain radioactive materials that may be potentially hazardous to employees and the general public, radiation control programs within the various agencies vary considerably, and range from inadequate to comprehensive and effective. Uniform standards, procedures, and guides are needed for use by the agencies.

(3) Federal specifications for purchase of equipment and requirements for disposal of equipment do not always include considerations of safety to the users or the public.

(4) While the safety and efficacy of radiopharmaceutical and radiobiological products are subject to Federal control, no other products or devices, either domestic or imported, containing radium or accelerator-produced radionuclides and sold in interstate commerce are required to meet Federal safety standards.

C. Control of the Sale of Used Electronic Products

The need for controlling the sale of certain used electronic products, specifically secondhand x-ray machines, was evaluated from the viewpoint of manufacturers, dealers, and State radiological health program directors, and by analysis of State x-ray survey data on secondhand x-ray machines. Major conclusions are:

(1) There is no need at this time for separate standards for secondhand x-ray equipment. Most secondhand equipment can be upgraded to meet existing recommended standards.

(2) Controls are needed to insure that secondhand x-ray equipment is not sold or transferred without being upgraded to meet standards for new products.

D. Use Standards

The study of the necessity for the development of standards for the use of nonmedical electronic products for commercial and industrial purposes was limited to industrial radiographic and fluoroscopic x-ray units, particle accelerators, and analytical x-ray equipment. From this study, it is concluded that:

In general, there is a lack of State control in this area. Federal performance standards under the authority of Public Law 90–602 should provide much of the control needed for the safe use of particle accelerators, analytical x-ray equipment, and industrial x-ray equipment. Such equipment is designed to produce radiation and the hazard relates largely to conditions of use. Such standards must include instructions which control conditions of use which affect radiation safety including location, facility design and shielding, safety interlocks, warning devices, and proper radiation safety procedures. Adequate training of operators and a good radiation safety program including inspections and surveys, as well as certification or licensure of operators by State agencies, can play an important role and provide the additional controls needed in the safe use of these types of electronic products.

E. Detection and Measurement of Electronic Product Radiation

The development of practicable procedures for the detection and measurement of electronic product radiation that may be emitted from electronic products manufactured or imported prior to the effective date of any applicable standard was studied, resulting in the following major conclusions:

(1) Practicable procedures are available for the identification and location of potentially hazardous electronic products manufactured or imported prior to the date of any applicable standards.

(2) Practicable procedures have been developed for measuring and evaluating certain types of electronic product radiation

from particular types of products, but procedures, including instrumentation, need to be developed for many other types of electronic product radiation.

PRIORITY 2. Resources

This Act has been carried out within the existing budget to investigate electronic products that emit nonionizing radiation and to initiate a program of research and investigation by public and private organizations into the health effects of such radiation emissions. Additional research and development is needed to develop instruments for measuring nonionizing radiation. Survey methods and techniques need to be developed for surveillance and inspection of potentially hazardous electronic products. Trained manpower for the electronic product radiation control program must be developed for State and local agencies as well as for Federal programs. The Department has reprogrammed several hundred thousand dollars from environmental surveillance activities during 1969 for new projects related to this Act. Additional reprogramming would require a reduction in radiological health programs related to radionuclides used in industry and the healing arts and could adversely affect public health and safety.

PRIORITY 3. Identification and Evaluation of Electronic Products

It is important to identify and evaluate the most significant sources of electronic product radiation, promulgate performance standards that will establish health-related criteria for emissions of radiation from electronic products, and establish an enforcement program to see that the manufacturers of electronic products comply with prescribed standards. One objective will be to establish a data bank of electronic product information concerning the inventory, distribution, radiation, and classification in order to anticipate potential consumer problem areas as they relate to radiation exposure. The rapidly increasing growth of the electronics industry is providing an expanding market of readily available electronic devices for utilization by industry and the general public for a variety of purposes. Since many of these products may be capable of producing radiation, a systematic review and investigation will be necessary to ascertain the safety of their use.

PRIORITY 4. Bioeffects Studies

Standard setting ultimately requires a sound biological basis. This has been emphasized many times and was further underscored in the scientific symposium "The Biological Effects and Health Implications of Microwave Radiation," cosponsored by the Department and the Medical College of Virginia, and held in Richmond, Va., on September 17–19, 1969. A general problem facing the Department is the lack of information to speak adequately to questions concerning the risk to human populations from insults of electronic product radiation. Adequate support given to epidemiologic studies of human populations, to relevant animal studies, and for the development and utilization of analysis techniques that would aid in assessing the health implications of exposure to all types of electronic product radiation will help to overcome this problem.

PRIORITY 5. Training

Training of State personnel, particularly in the nonionizing area, has been undertaken, thus providing a nucleus of State personnel to conduct joint programs with the Department. It is anticipated that the number of trained personnel will increase as additional training courses are presented.

PRIORITY 6. Records and Reporting

The number of laser manufacturers is growing and sales of small units are increasing. This tends to make registration of laser devices more difficult and time consuming; additionally, laser devices are being sold as components (such as the helium-neon laser tube) rather than complete systems. These components can be purchased by individuals to form the basis of a laser, or by manufacturers, who include the components as part of a larger system. Use of lasers ranges from research, with potential hazard to only one or a few persons, to education, where some strict control is needed because of the potential hazard to a whole class.

PRIORITY 7. Clearance Procedures

Possibilities for further expediting clearance procedures for publishing proposed and adopted regulatory standards are being investigated.

PRIORITY 8. Radiation Incidents Registry

Effective and continuing publicizing of the Radiation Incidents Registry will be required in order to maximize the response from reporting agencies and individuals. Failure of these agencies or individuals to provide adequate reports of incidents as they occur will seriously hamper the effectiveness of the Registry.

VII. ANALYSIS AND EVALUATION OF RESEARCH ACTIVITIES AND TECHNOLOGICAL PROGRESS

Requirement (*5*)

SEC. 360D (a) (5) an analysis and evaluation of research activities completed as a result of Government and private sponsorship, and technological progress for safety achieved during such year.

Action

A **microwave power density meter,** commercially available, has proved to be a satisfactory field and laboratory instrument. Its accuracy, stability, and isotropicity are significantly superior to those of instruments previously available. The Department is now employing this device both in field surveys and product evaluations in the laboratory.

A significant contribution was the development of an **electronic x-ray pulse counter.** This device will be used to check the performance of diagnostic x-ray timers. Properly operating x-ray timers greatly enhance the safety of x-ray machines by reducing unnecessary exposure of patients to x rays. This device has been proved to work successfully under laboratory conditions and is currently undergoing field evaluation.

Personnel of the Department have completed measurements of **far-field emissions from a microwave oven.** In order to do this study, personnel designed and fabricated several pieces of apparatus: tower, standard gain horn, position transducers, coordinate converters, and antenna towers. This equipment was calibrated against standards and the first complete map of emissions drawn. Currently, data are under analysis and attempts are being made to construct a three-dimensional model of the emission field.

The Department has also designed and developed a prototype **laser hazard meter** for measurement of continuous-wave low-power lasers. Sensitivity on this unit is in the microwatt range. The laser hazard meter will provide a direct readout of laser power density. The cost of construction (parts—less than $50) and its portability (battery operated and handheld) make it attractive for field use. Designed for relatively untrained personnel, the laser hazard meter has a sonic alert device coupled to the metering system that alerts the user to unsafe light levels. Calibrated scales are included for more sophisticated use.

Considerable progress has been made in the long-term contract study with beagles at Colorado State University, which was designed to answer questions related to the **risk of human fetuses** from radiography of pregnant women (*13*). Electronic techniques have been developed to determine eye pathology prior to the time of frank cataract development. These techniques will be extremely valuable in microwave exposure studies since the eye is a critical organ for microwave exposure.

Under construction at the Department's Southwestern Radiological Health Laboratory is a shielded room to be used for **calibration of microwave measuring equipment.** Plans are underway to secure sufficient space for construction of a **laser laboratory.** The laboratory will be used to develop both measurement and laboratory safety techniques.

The Department undertook studies to develop **dosimetry systems** to evaluate microwave exposure. The studies were limited to two systems and to determining if microwaves had a detectable effect on the systems.

In one system, the **effects of microwave irradiation** on the optical activity of selected organic compounds were investigated. The objective of this program was the development of a microwave dosimeter based on changing the optical activity of a compound with microwave irradiation. It was found that the optical activity of sucrose in aqueous solution containing viscosity modifiers can be reduced in proportion to the amount of incident microwave irradiation.

A second study was initiated to determine the feasibility of using **thermoluminescent dosimetry** (TLD) material to indicate microwave exposure. These irradiated ionizing TLD materials were subjected to microwave radiation and the reduction in light output because of the absorption of microwave energy was evaluated. The results of this study are being evaluated and appear to be very promising.

Major technological accomplishments were attained in the area of **product testing and evaluation.**

Twenty-two **color television receivers** were identified during surveys on manufacturers' premises as being capable of emitting x radiation. These sets were brought in to the Department's laboratories to (1) develop data on x-ray emission as compared to the three phases of the standard for the control of television set x radiation, (2) verify measurements made during the inplant television survey, (3) identify specific receiver components emitting excessive x radiation, and (4) prepare recomendations for reducing or eliminating excessive x radiation. The results of this testing program confirmed that excessive high voltage is the predominant cause of x radiation from color television sets.

Additional tests and evaluations were completed on **microwave ovens.** A report was prepared and is expected to be printed and distributed early in 1970. The measurements were made to determine, under laboratory conditions, the levels of microwave radiation that the user of an oven could be exposed to with: (1) the oven on and the door closed; (2) the door in the process of being opened; and (3) the interlocks defeated and the door completely opened. The tests were also made to gather information in support of the need for a performance standard for microwave ovens.

A **television projection system** was evaluated in the laboratory and found to emit excessive levels of radiation that could expose the operator and adjacent viewers. Plans are being made to perform additional tests on this type of product in the development of a performance standard.

In the area of measurement of microwave radiation from electronic devices, Bendix Research Laboratories, under contract from the Department, has developed a new type of **microwave measuring system.** With this system, electrical power is easily measured with an accuracy difficult to achieve with a conventional microwave field strength or power density meter.

Further laboratory investigations on **Bremsstrahlung production** will permit the Department to estimate absolute radiation production and angular distribution from specific electronic systems in which targets are bombarded by high-energy electrons. Bremsstrahlung is defined as secondary photon radiation produced by deceleration of charged particles passing through matter. A routine thermoluminescent dosimetry system has been established, calibrated, and evaluated. This permits the Department to make measurements of integrated ionizing radiation exposure accurately and inexpensively. It also permits the determination of spatial distributions of ionizing radiation because the small size and low cost of the dosimeters make it feasible to use a large number of them in any given experiment or study.

An instrument, developed by the Department, is commercially available for **measuring ionizing radiation** exposure rate that is accurate over a wide range of photon energy and conforms to the detector size requirements of the proposed performance standard for television receivers.

Laboratory studies have established that the counting rate output of some **thin window Geiger-Mueller counters** is sufficiently roentgen-equivalent over the photon energy range observed to be emitted from television receivers that they can be used as detectors in very sensitive and accurate survey instruments. An instrument employing a detector of this type is under development.

Departmental Regional Offices and State health agencies have participated with the Department personnel in a series of applied fact-finding activities. Among these was the joint survey into the use of **demonstration-type cold cathode gas discharge emission tubes** in secondary schools. These surveys resulted in a voluntary compliance action by the Department. Additional surveys have been performed on microwave ovens, laser devices, ultraviolet light exposure, and ultrasonic sources. These latter surveys were conducted to define whether a problem existed in the use of these devices. A continuing project is presently underway by which State agencies are evaluating the safety of use of new medical x-ray machines.

Plans are underway for a joint State–Department survey of **medical diathermy treatment equipment.** The purpose of this project is to determine the nature and extent of the potential radiation hazards to individuals who are or have been exposed to radiation from shortwave, microwave, or ultrasound diathermy sources. This will be accomplished by a field survey and evaluation of 100 to 200 diathermy devices of all types.

Studies are being planned in such areas as nonmedical use of microwave-producing devices, ultrasonic cleaner use, and other radiation-emitting products.

A final report was published on the U.S. **Population Dose from X-rays** as determined from the 1964 exposure study, household interview surveys, followup surveys of x-ray facilities, and experimental dosimetric model data (*3*). This report estimated the genetically significant dose. It was estimated that restriction of the x-ray beam to an area no larger than the film size would reduce the genetically significant dose from 55 to 19 millirads per person per year.

Several pilot studies have been conducted with various biological systems to compare the **effects of simulated television** x rays (25 kVcp) and higher energy x rays (250 kVcp). In general, these studies indicate that x rays of the two different energy levels produce comparable biological effects with equivalent absorbed doses.

Co-insult studies have demonstrated the enhancement of virus infection of cells exposed to ionizing radiation. Co-insult studies have also been carried out with radiation and chemical agents (*1*). These findings accentuate the possible unknown effects on man from multiple environmental insults.

Preliminary bioeffects research studies have demonstrated that microwaves can induce **chromosome abnormalities** and alter protein synthesis (*2,3*). These results support reports indicating that microwaves can produce extensive somatic effects and possibly even genetic effects. Several reports have been published on the biological effects of ionizing radiation in experimental animals, including neurological effects, effects on the thyroid, hematological effects of in utero irradiation, effects of in utero irradiation on protein synthesis, and the radioprotective effects of hematopoietic cells (*14–20*).

The Department has several research contracts that are concerned with **safe and more efficient use of radiation in the healing arts.** These are:

1. Technical and Clinical Evaluation of the Fluoroscopic Image Storage System (Emory University)—Purpose is to fabricate and assemble a television system incorporating integrated image retention and display with conventional fluoroscopic image intensification; perform a technical and clinical investigation of the application of TV Image Storage System for reduction of x-ray exposure to patients and personnel during fluoroscopic procedures and for the increased efficiency in the performance of selected clinical examinations.

2. Development of Orbital Multi-Directional X-ray Fluoroscopy Apparatus (University of Pennsylvania)—Design and construct a multi-directional remote controlled x-ray fluoroscopy apparatus that will correct certain diagnostic medical radiological problems related to myelography, GI fluoroscopy, and selective bronchography, for example.

3. Testing of the Alderson-Machlett Radiographic Phantom (University of Miami)—To evaluate the Alderson-Machlett Diag-

nostic Phantom as to its performance and reliability as a training aid in the teaching of radiographic technique to students of radiologic technology.

4. Reduction of Patient Exposure Through the Application of ADP Techniques to Diagnostic Radiology Operations (The Johns Hopkins University)—Develop and evaluate a system that will reduce the need for "duplicate" x-ray examinations through the use of automatic data processing techniques.

5. Potential Radiation Exposure Reduction by an Information and Communications System Analysis in Hospital Diagnostic Radiology (Massachusetts General Hospital)—To define a system aimed at recording and reducing patient exposure to x rays with concurrent improvement in diagnostic radiology operations at Massachusetts General Hospital.

6. Study for Information and Communication Systems Analysis in Hospital Diagnostic Radiology to Reduce Exposure and Conserve Manpower by Use of a Shared Medical Computer (Emory University)—To (1) review pertinent studies conducted at Emory University and Grady Memorial Hospitals and related research conducted at other university centers, particularly at The Johns Hopkins Medical Institutions; (2) identify the data base required to meet the study objectives in terms of type, content, format, volume, and frequency of transmittal; (3) identify data requirements common to diagnostic radiology operations at both institutions and those that are unique to each department; (4) specify current and future operational objectives in terms of functional requirements to meet the information needs at both local and national levels; (5) develop an initial system design; (6) conduct tradeoff studies and cost effectiveness analysis of alternative designs; and (7) prepare specifications for a shared system in terms of input operation and output, based on the results of the preceding tasks.

In addition to these contracts, the Department is supporting several prototype programs designed to improve the **healing arts radiation use systems.** These are:

1. Radiological Health and Science Education Project (University of California)—To organize, develop, maintain, and operate a program unit to explore new educational concepts in radiological health science education related to the most efficient and safe use of ionizing radiation in medicine.

2. Development of Teaching and Training Programs in X-ray Sciences (Oregon State University)—To provide teaching and training in X-ray Science and Engineering by maintaining and

further developing training courses acceptable with the University's established program.

3. Determination of Requirements for Establishing a Training Program for Teachers of Oral Radiology (University of Alabama)—A study will be made to determine what resources would be required and what time schedule would be necessary for establishing programs of instructions for teachers of dental radiology, both in dental schools and schools of dental auxiliaries. For this study the training programs shall be considered to incorporate an adequate amount of instructions in radiation exposure and the efficient use of ionizing radiation.

4. Development of a Prototype Training Program for Radiology Administrators (University of Cincinnati)—To organize and develop a program unit for Radiology Administrators, carry on teaching and training, and conduct research, evaluation, and development activities that will advance the state of art in this field.

5. Development of an Education Plan for Granting of Associate of Arts Degree in Radiologic Technology (Emory University)—To (1) devise a 2-year curriculum for radiologic technologists including development of the required technologist technical material into accreditable courses for college degree work; (2) prepare lesson plans for the newly devised courses and explore methods to evaluate trainees that have completed the program in comparison to those that have completed present hospital based programs; and (3) assist in implementing the program through providing equipment and student and faculty support, and assure establishment and conduct through the DeKalb College and affiliated hospitals of an accreditable associate degree program for radiological technologists.

6. Studies of Professional and Technician Manpower Utilized by Medical Radiation Use Systems (The American College of Radiology)—To conduct studies to define the varying levels of job responsibilities and functions of medical or radiological physicists, radiation biologists, dosimetrists, radiation safety officers, and administrator staff in radiology and the related knowledge and skill requirements for each function; to develop recommendations relative to accredited curriculums and required experience for professions mentioned above.

VIII. COMPLETED OR PENDING JUDICIAL ACTIONS

Requirement (6)

SEC. 360D. (a) (6) a list, with a brief statement of the issues, of completed or pending judicial actions under this subpart.

Action

There were no actions to report.

IX. DISSEMINATION OF TECHNICAL AND CONSUMER-ORIENTED INFORMATION

Requirement (7)

SEC. 360D. (a) (7) the extent to which technical information was disseminated to the scientific, commercial, and labor community and consumer-oriented information was made available to the public.

Action

A list of technical reports prepared by staff of the Department in calendar year 1969 is included in the Appendix to this Report. The list illustrates some of the Department's efforts in the promotion of good radiological health practices. Documents were distributed to groups and individuals within the scientific, commercial, and labor communities. Special effort was made to reach health physicists, radiologists, and related professional groups.

Twenty-five news releases, most of them consumer-oriented, were issued to general news media and commercial, scientific, professional and trade papers, and journals. Some of these summarized findings and presentations of Department reports and other publications, and thus served to extend audiences for this type of work. Other releases served to acquaint the general public with the television receiver x-ray problem, regulations and standards development under the Radiation Control for Health and Safety Act, other radiation control actions, Department contributions to radiation control actions, and Department contributions to radiation research and protection improvement technology.

Consumer-oriented publications concerning radiation from electronic products were distributed in response to inquiries received from the general public. These documents were frequently accompanied by interpretive letters. More than 2,800 public inquiries were answered from the Washington offices this year. Regional radiological health staff of the Department also handled public inquiries and provided support to State radiological health units to answer public inquiries.

Technical and radiological health information was disseminated by means of short-term courses developed and operated by the Training Institute of The Environmental Control Administration, Department of Health, Education, and Welfare. These courses were conducted for individuals from the U.S. Public Health Service, industry, hospitals, teaching institutions, Federal health-oriented agencies other than Public Health Service, State and local health departments, and the Department of Defense (table 4). Thirty different courses were given on 96 occasions during 1969. A list of short-term training courses is included in the Appendix to this Report.

TABLE 4. *Attendees of short-term courses in radiological health*

Employee category	Number of attendees	Percentage
U.S. Public Health Service	466	22
Department of Defense	523	25.1
Other Federal	71	4.9
State	269	13.9
Local	123	6.7
Foreign	23	1.3
Consultant	6	.3
Hospital	213	10.7
Industry	210	10.1
University	99	3.1
Other	37	1.9

In addition to the manuals and technical material items distributed in support of the training program, course manuals and reprints of various technical publications were made available to groups, such as university libraries, in response to requests for technical assistance and consultation. Radiological health training grants, emphasizing ionizing radiation, support university graduate level radiological health specialist projects, community college level radiological health technician projects, and special health science curricula.

Through meetings and individual conferences with university and technical school program directors, curricula changes were instigated to reflect new training demands on the radiological health specialist and technician graduate as control aspects of Public Law 90–602 are implemented.

During 1969, exhibits of radiological health activities were shown at 11 major national professional meetings. Exhibits were also loaned to State health departments to assist them in disseminating technical information to the scientific community at State and local levels.

The Department promoted, either by sponsorship, cosponsorship, or active participation, 11 major conferences and symposia during 1969 on various topics in radiological health. These events are an important means of communicating information not only to members of the scientific community but the general public since coverage frequently is provided by the mass communications media. A list of these meetings is included in the Appendix to this Report.

X. COOPERATION BETWEEN GOVERNMENT AND INDUSTRY AND OTHER INTERESTED PARTIES

Requirement (8)

SEC. 360D. (a) (8) the extent of cooperation between Government officials and representatives of industry and other interested parties in the implementation of this subpart including a log or summary of meetings held between Government officials and representatives of industry and other interested parties.

Action

Examples of cooperation between the Department, other Federal agencies, and industry are cited under *Requirement (7)*, particularly in the fields of short-term training courses, long-term training grants, seminars, and symposia.

At various times during calendar year 1969, Department personnel visited public agencies, met with industry and industrial associations, and visited manufacturers' plants in connection with the Department's broad concern for public health aspects of radiation. The log of visits is included in the Appendix to this Report. It illustrates the Department's continuing effort to reduce unnecessary, potentially hazardous radiation.

The Department has appointed an official observer to the Electronic Radiation Management Advisory Council (ERMAC) whose function is to "advise and make recommendations to the Director of Telecommunications Management on government and nongovernment activities bearing on the adequacy of control of electromagnetic radiation application including safety and/or harmful effects of biological systems as well as on equipment and material." The Director of Telecommunications Management serves as an assistant director of the Office of Emergency Planning.

Liaison has been established by the Department with the Electromagnetic Compatibility Analysis Center (ECAC), a Department of Defense facility, established to provide advice and assistance on electromagnetic compatibility matters to the Secretary of Defense, the Joint Chiefs of Staff, the military departments, and other DoD components. The Center serves other government agencies and civilian activities as resources permit.

Working compatibility and liaison has been established between the Department and the Research Division, Intrusion Detection and Sensor Laboratory, Combat Development Center, Fort Belvoir. This appears to be an extremely important step for the Department in the field of x-ray exposure reduction to the total population.

The Department has been invited to appoint an observer to Project Sanguine in order to participate in briefings of interest to the Department in carrying out any responsibilities it might have with respect to public health implications of any extra low-frequency emissions from the project. Project Sanguine is a two-phase research, development, test, and evaluation program of the U.S. Navy, for the development of a single transmitter complex located in the United States that could provide communications with forces deployed worldwide. An ad hoc committee to Project Sanguine for biological effects has been appointed and the Department maintains representation on this committee.

Numerous other contacts and liaison activities are maintained by the Department with various activities of the Department of Defense and other agencies (Advanced Research Projects Agency, Institute for Defense Analyses, Environmental Science Services Administration, Central Intelligence Agency, Edgewood Arsenal, Army Environmental Hygiene Agency, Coast and Geodetic Survey, U.S. Coast Guard, and so forth). Liaison is also maintained with the British Liaison Office, British Embassy, and with the Canadian Academy of Science in Ottawa.

Cooperative efforts between State agencies and the Department in performing surveys and investigations included joint surveys of the cold cathode gas discharge tubes and microwave oven surveys. Instrumentation appropriate for color television surveys and microwave instrumentation have been loaned to State agencies for their use in performing surveys. Department personnel have participated in the investigations.

Since September 1968, the Department has supported studies of the theory, techniques, and instrumentation for measuring electromagnetic fields at the National Bureau of Standards at Boulder, Colo. On June 23, 1969, representatives of the National Bureau of Standards and the Department met to discuss areas of common interest, particularly with respect to Public Law 90–602. As a result of that meeting, a liaison committee was organized to identify areas where the National Bureau of Standards might provide technical services in the areas of ionizing radiation and nonionizing radiation.

The Department has sought the assistance of the National Bureau of Standards on various occasions on matters relating to ionizing radiation measurements because of the fundamental role of the National Bureau of Standards in the field of measurements. Wherever possible, secondary standards used by the Department will trace back to National Bureau of Standards primary reference standards.

The Business and Defense Services Administration of the Department of Commerce and the Electronics Industry Association provided the Department staff with considerable statistical information on industry production and sales of electronic products. They further provided valuable advice concerning other sources of this type of information.

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APPENDIX

TECHNICAL REPORTS AND ARTICLES PUBLISHED BY THE BUREAU OF RADIOLOGICAL HEALTH, CALENDAR YEAR 1969

An Automatic Sample Changer for Solid State Alpha-Spectroscopy (in Nuclear Instruments and Methods).

Analysis of Tritium in Water: A Collaborative Study (in Journal of the Association of the Official Analytical Chemistry).

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Biological Aspects of Laser Radiation: A Review of Hazards (PB 184 003)[1].

Blood and Skeletal Levels of ^{210}Po as a Measure of Exposure to Inhaled Radon Daughter Products (in Health Physics).

Cs–137 Uptake by Oat Plants as Related to the Soil Fixing Capacity (in Health Physics).

Cs–137 Body Burdens and Biological Half-life in Children at Tampa, Fla., and Lake Bluff, Ill. (in Health Physics).

Clinical Experience with Oblique Views in Pulmonary Perfusion Camera-Imaging in Normal and Pathological Anatomy (in Radiology).

Congenital Cataract in the Rat (in Archives of Ophthalmology).

Content and Distribution of Stable Strontium and Ra-226 in the Human Skeleton (in British Journal of Radiology).

Dental Surpak Summary Report (MORP 68–11 REV) (PB 184 356)[1].

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[1] Available from the National Technical Information Service, Springfield, Va. 22151.

TECHNICAL REPORTS AND ARTICLES PUBLISHED BY THE BUREAU OF RADIOLOGICAL HEALTH—CALENDAR YEAR 1969 (continued)

Disposal of Radioactive Wastes from U.S. Naval Nuclear-Powered Ships and Their Support Facilities, 1967 (in Radiological Health Data and Reports).

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Effective Half-times of Sr–85 and Cs–134 for a Contaminated Pasture (in Health Physics).

Effects of Radiation and Ethionine on Rat Mammary Incidence (in Radiation Research).

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Effects of Gamma Irradiation on the Postnatally Developing Canine Cerebellar Cortex—II. Sequential Histogenesis of Radiation-induced Changes (in Journal of Neuropathology and Experimental Neurology).

Environmental Surveillance Around a Nuclear Fuel Reprocessing Installation, 1965–1967 (in Radiological Health Data and Reports).

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Evaluation of Atmospheric Radon in the Vicinity of Uranium Mill Tailings (in Health Physics).

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Evaluation of Radium Contamination in Aircraft Instrument Repair Facilities (PHS Publ. No. 999–RH–36) (PB 189 141)[1].

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[1] Available from the National Technical Information Service, Springfield, Va. 22151.

TECHNICAL REPORTS AND ARTICLES PUBLISHED BY THE BUREAU OF RADIOLOGICAL HEALTH—CALENDAR YEAR 1969
(continued)

Evaluation of Radium-226 in Total Diet Samples, 1964 to June 1967 (in Radiological Health Data and Reports).

Field Method for the Determination of Lead in Glass Used for Shielding Television Receiver Components (DEP 69-2) (PB 188 703)[1].

Fine Structure of Formed Elements in Canine Blood (in American Journal of Veterinary Research).

Fine Structure of the Dog Eye—The Iris (in American Journal of Veterinary Research).

Fine Structure of Thyroid Epithelium of Young Dogs Treated with Thyrotropin (in American Journal of Veterinary Research).

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Leak Testing Sealed Sources of Radium-226 by Radon Photography (in Health Physics).

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[1] Available from the National Technical Information Service, Springfield, Va. 22151.

TECHNICAL REPORTS AND ARTICLES PUBLISHED BY THE BUREAU OF RADIOLOGICAL HEALTH—CALENDAR YEAR 1969
(continued)

Levels of Stable Strontium in Milk and the Total Diet (in Environmental Science and Technology).

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Low-level Counting by Liquid Scintillation—I. Tritium Measurement in Homogeneous Systems (in International Journal of Applied Radiation).

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Percent Ce–134 and Sr–85 in Milk, Urine, and Feces of Goats on Normal and Verxite-containing Diets (in Journal of Dairy Science).

A Perspective on Potential Radiation Hazards (BRH Seminar Paper No. 004).

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Plutonium–239 in Human Tissues and Bone (in Radiological Health Data and Reports).

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TECHNICAL REPORTS AND ARTICLES PUBLISHED BY THE BUREAU OF RADIOLOGICAL HEALTH—CALENDAR YEAR 1969 (continued)

Rad-Ad: A New Management Position for Radiology (in American Journal of Public Health).

Radiation Bio-Effects, Summary Report, January-December 1968 (PHS 1809) (PB 183 797)[1].

Radiation Doses to Children's Thyroids from Iodine-131 in Milk (in Radiological Health Data and Reports).

Radiation Exposure Overview—Microwave Ovens and The Public (OCS 69-1) (PB 188 690)[1].

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Radiological Health Aspects of Spent Radon Seeds (in Radiological Health Data and Reports).

Radiological Surveillance Studies at a Boiling Water Nuclear Power Reactor (DER 69-2).

Radioprotective Effect of Rat Kangaroo Haematopoietic Cells on X-irradiated Mice and Chinese Hamsters (in International Journal of Radiation Biology).

Radium Disposal Project (PB 184 096)[1].

Rapid Dental X-ray Film Processor for Selected Procedures (in Journal of Oral Surgery, Oral Medicine, and Oral Pathology).

The Rat Kangaroo—Handling and Husbandry Practices in a Research Facility (in Laboratory Animal Care).

Regulations, Standards and Guides Pertaining to Medical and Dental Radiation Protection—An Annotated Bibliography (PHS Publ. No. 999-RH-37) (PB 189 142)[1].

Regulations, Standards, and Guides for Microwaves, Ultraviolet Radiation, and Radiation from Lasers and Television Receivers—An Annotated Bibliography (PHS Publ. No. 999-RH-35) (PB 189 360)[1].

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[1] Available from the National Technical Information Service, Springfield, Va. 22151.

TECHNICAL REPORTS AND ARTICLES PUBLISHED BY THE BUREAU OF RADIOLOGICAL HEALTH—CALENDAR YEAR 1969 (continued)

Report of the Task Force on X-ray Image Analysis and Systems Development (DMRE 69–1) (PB 184 130)[1].

Retention of Radiostrontium, Strontium, Calcium, and Phosphorus by Infants (in Supplement to Pediatrics).

A Review of Radium Incidents in the United States (SM–119/26 —Speech by J. Villforth—Vienna, Austria, May 19–23, 1969: Previously MORP 68–7).

Sequential Determinations of the in situ Distribution of I–131 Labeled Tetracycline in Cats Using the Scintillation Camera (in Journal of Nuclear Medicine).

Some Physical Factors Affecting Radiographic Image Quality: Their Theoretical Basis and Measurement (PHS Publ. No. 999–RH–38) (PB 187 724)[1].

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Studies of Chemical and Radiochemical Composition of Natural Gas from the Cavity Produced by the Project Gasbuggy Nuclear Shot (in Radiological Health Data and Reports).

Studies of Ion Exchange Resins for the Removal of Radionuclides from Milk (in Health Physics).

Study of the Parameters Influencing the Clinical Use of I–133 (Abstract in Journal of Nuclear Medicine).

Summary of Diagnostic X-ray Statistics Relating Facilities, Equipment, and Personnel by Healing Art Professions (in Radiological Health Data and Reports).

Survey of the Use of Radionuclides in Medicine (in Isotopes and Radiation Technology).

Survey of Veterinary X-ray Units in Alabama (in Radiological Health Data and Reports).

Symposium on Past, Present, and Future State X-ray Programs (DMRE 69–2) (PB 184 481)[1].

The Use of Radium in Consumer Products (MORP 68–5).

Tritium in the Environment from Nuclear Power Plants (in Public Health Reports).

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TECHNICAL REPORTS AND ARTICLES PUBLISHED BY THE BUREAU OF RADIOLOGICAL HEALTH—CALENDAR YEAR 1969 (continued)

A Tritium Monitor Based on Scintillation (in Nuclear Instruments and Methods).

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Verxite Flakes for in vivo Binding of Cs–134 in Cows (in Journal of Dairy Science).

X-radiation Control Programs in Color Television Industry—Summary Report on Visits to Manufacturers (DEP 69–1) (PB 185 979)[1].

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[1] Available from the National Technical Information Service, Springfield, Va. 22151.

SHORT-TERM COURSES IN BIOLOGICAL HEALTH PRESENTED IN 1969

Course type and title	Times presented	Course duration (days)	Number of attendees
Ionizing Radiation Protection			
Accelerator Radiator Protection	5	5	101
Fundamentals of Medical X-ray Protection	1	5	20
Medical X-ray Protection	5	10	226
X-ray Shielding Design	1	2	22
Nonionizing Radiation			
Fundamentals of Nonionizing Radiation Protection	6	5	147
Surveillance			
Survey Methods	1	2	4
Occupational Radiation Protection	11	10	226
Operational Aspects of Radiation Surveillance	1	10	19
Radiation Protection Guides and Dose Assessment	1	10	14
Radionuclide Analysis by Gamma Spectroscopy	4	10	73
Reactor Safety and Hazards Evaluation	1	10	27
Monitoring Courses (SNAP-27 and Rulison)	2	2 & 5	53
Basic & Introductory			
Basic Radiological Health	17	10	373
Introduction to Radiological Health for X-ray Technologists	7	2–3	73
Introduction to Dental Radiation Protection	1	1	23
Fundamentals of Radiation Protection for Radionuclide Toxicology Personnel	1	1.5	12
Fundamentals of Radiological Health	3	5	56
Introduction to Radiological Health	1	.5	81

SHORT-TERM COURSES IN RADIOLOGICAL HEALTH PRESENTED IN 1969 (continued)

Course type and title	Times presented	Course duration (days)	Number of attendees
Introduction to Radiological Health	1	1	8
Orientation Course for Engineers and Environmental Health Personnel	1	5	39
Radiological Health for Nurses	3	5	63
Radiological Health for Pharmacists	1	5	23
Radiological Health for Radionuclide Uses	2	10	58
Radiological Health for Supervisory X-ray Technologists	7	5	127
General			
Contract Orientation for Project Officers	2	1	59
COSTEP Orientation Course	1	3	6
Introduction to Automatic Data Processing	1	4	8
Management of Radiation Accidents	5	5	104
Orientation of Bureau of Radiological Health	1	2	30
Orientation to Environmental Control Administration	2	1	99

LOG OF VISITS TO PUBLIC AGENCIES, MANUFACTURERS' PLANTS: CONSULTATIONS WITH INDUSTRY AND PUBLIC AGENCIES BY STAFF OF BUREAU OF RADIOLOGICAL HEALTH, CALENDAR YEAR 1969

Date	Agency, Organization, or Industry	Purpose
Jan. 9	Electronic Industries Association	Discuss results of TV set survey.
Jan. 10	National Electrical Manufacturers' Assoc.	Request cooperation in the used x-ray equipment study.
Jan. 10	Bionic Instruments, Inc., Bala-Cynwyd, Pa.	Obtain information relating to the radiation safety of a laser cane.
Jan. 14	American National Standards Institute, Subcommittee N 43.1.	Discuss A.N.S.I. recommended standards for analytical x-ray equipment.
Jan. 21	Westinghouse Corporation	Discuss present status of x-ray apparatus and means of reducing patient exposure.
Jan. 31	American Academy of Dental Radiology.	Participate in workshop on x-ray user legislation and training and certification requirements for dental auxiliaries.
Feb. 4, 5	Delaware State Health Department	Assist in microwave oven survey by supplying technical knowledge, instrumentation and survey forms.
Feb. 17	U.S. Army	Exchange information on approaches to laser safety programs.
Feb. 17–22	American College of Radiology	Discuss radiologic technologist licensure.
Feb. 18	American College of Radiology, Committee on Devices.	Discuss how users and manufacturers of medical x-ray apparatus might be affected by P.L. 90–602.
Mar. 5	Field Emission Corporation	Discuss P.L. 90–602 as related to Field Emission Corp. activities.
Mar. 6	Dental Trade Association	Request cooperation in the used x-ray equipment study.
Mar. 11	American National Standards Institute, Subcommittee N 43.1.	Discuss A.N.S.I. recommended standards for analytical x-ray equipment.
Mar. 17	American National Standards Institute, Subcommittee N 43.4.	Participate in development of particle accelerators standards.
Mar. 24	All State Health Departments, Montgomery, Ala.	Participate in workshop on implementation of P.L. 90–602.
Mar. 28	Electronic Industries Association	X-radiation measurement conference.
Spring	Machlett Laboratories, Springdale, Conn.	Discuss design of new x-ray equipment.
Apr. 4	Underwriters' Laboratory	Discuss standards and procedures utilized by U.L. for the evaluation of radiation from microwave ovens.
Apr. 7–9	Various accelerator manufacturers and users.	Discuss possible accelerator standards as related to P.L. 90–602.
Apr. 14	American Chiropractic Association	Participate in meeting of the Council on Roentgenology.

Date	Agency, Organization, or Industry	Purpose
Apr. 21	North Carolina State Health Department, Raleigh, N.C.	Arrange for data retrieval of surveys on used x-ray equipment.
Apr. 22	Electronic Industries Association	Discuss x radiation from TV receivers.
Apr. 22	Kentucky State Health Department, Frankfort, Ky.	Arrange data retrieval of surveys on used x ray equipment.
Apr. 23	American National Standards Institute, Subcommittee N 43.1.	Discuss A.N.S.I. recommended standards for analytical x-ray equipment.
Apr. 25	National Electrical Manufacturers' Assoc.	Review and discuss the used x-ray equipment study called for in Sec. 357, P.L.90–602.
Apr. 26	Westinghouse Corporation	Discuss development of x-ray performance standards.
Apr. 30–May 1	American National Standards Institute, Subcommittee N. 43.	Discuss equipment standards for nonmedical radiation applications.
May 1	New York City Department of Health.	Discuss development of x-ray performance standards.
May 5	Westinghouse Corporation	Discuss possible standards to be promulgated under P.L. 90–602 regarding collimating devices for x-ray apparatus.
May 7	Association of Home Appliance Manufacturers.	Privide a briefing on the status of radiation emissions from microwave ovens.
May 11	Association of Home Appliance Manufacturers, San Carlos, Calif.	Observe microwave survey meters.
May 14	Association of Home Applicance Manufacturers.	Provide briefing on the status of radiation emission from microwave ovens.
May 15	New Jersey State Health Department, Trenton, N.J.	Arrange data retrieval of surveys on used x-ray equipment.
May 21	Electronic Industries Association	Discuss x radiation from TV receivers.
May 23–28	The Ad Hoc Committee comprised of representatives from industry and State and Federal Governments.	Develop a system to evaluate new x-ray equipment through cooperation of the State and Federal Governments.
May 24	Zenith Corporation	Quality control for color TV set production.
Spring	Machlett Laboratories Inc., Springdale, Conn.	Discuss design of new x-ray equipment.
June 5	Electronic Industries Association	Discuss x-radiation measurements for testing procedures for TV receivers.
June 8	California State Health Department, Berkeley, Calif.	Arrange data retrieval of surveys on used x-ray equipment.
June 9	American National Standards Institute, Subcommittee PH 6.	Discuss A.N.S.I. dental x-ray standards and their relation to standards to be developed under P.L. 90–602.
June 11	Association of Home Appliance Manufacturers.	Discuss proposed standards regarding interlocks on microwave ovens.
June 16	Honeywell Corporation	Discuss electromagnetic capabilities of the Honeywell Corporation.
June 16	Motorola Corporation, Franklin Park, Ill.	Discuss radiation dose calculations.

Date	Agency, Organization, or Industry	Purpose
June 19	General Electric Corporation and Bureau of Occupational Health, Kentucky State Department of Health, Louisville, Ky.	Observe plant conditions and procedures for measuring radiation from microwave ovens and to discuss the feasibility of design and production changes necessary to reduce or eliminate radiation emissions therefrom.
June 23	National Bureau of Standards	Inform NBS of the remifications of P.L. 90–602 and discuss how NBS can be useful and participate in new legislation and help in the development of instruments to measure various types of radiation.
June 24	Amana Corporation, Amana, Iowa	Review microwave oven production facility and radiation testing procedures.
June 24	Ad Hoc Committee for X-ray Radiation Safety Workshop.	Develop a symposia agenda that will discuss standards under P.L. 90–602.
June 25	Philco-Ford Corporation, Philadelphia, Pa.	Review data on x radiation of TV receivers.
June 29	Motorola Inc., Franklin Park, Ill	Discuss x radiation of TV receivers.
June 30	Federal Bureau of Prisons	Initiate agreement for surveying x-ray equipment.
July 2–3	American Society of Radiologic Technologists.	Discuss radiologic technology manpower availability and needs.
July 3	DuMont-Emerson, Jersey City N.J	Review x radiation factory test procedures (quality control).
July 7	McDonald Observatory, Midland, Tex.	Discuss laser safety.
July 10	National Electrical Manufacturers Assoc.	Discuss June 4, 1969 Notice of Intent to Issue Regulations under P.L. 90–602.
July 11	Varo Corporation	Discuss quality control records.
July 14	National Retail Merchants Association.	Discuss recordkeeping obligations of retail merchants under P.L. 90–602.
July 15	American College of Chest Physicians and American College of Radiology.	Participate in meeting on mass chest x-ray screening.
July 18	DuMont-Emerson, Jersey City, N.J	Quality control for color TV set production.
Aug. 7	Setchell Carlson	Quality control for color TV set production.
Aug. 14	Electro Technic Products, Chicago, Ill.	Discuss problems associated with x-ray emission from cold cathode gas discharge tubes.
Aug. 19	Philco-Ford Corporation, Philadelphia, Pa.	Quality control for color TV set production.
Aug. 21	American National Standards Institute, Subcommittee PH 6.5.	Attend meeting on dental x-ray standards.
Aug. 21, 22	Magnavox	Quality control for color TV set production.
Aug. 27	Electronic Industries Association	Discuss final version of proposed TV standard.
Sept. 5	Battelle Memorial Institute	Discuss BRH interest in low-frequency radiation problems.
Sept. 8	Georgia State Department of Health, Atlanta, Ga.	Participate in cooperative ultraviolet radiation survey.
Sept. 9	Association of Home Appliance Manufacturers.	Discuss microwave oven performance standard.

Date	Agency, Organization, or Industry	Purpose
Sept. 10	Federal Health Programs Service	Initiate agreement for surveying x-ray equipment.
Sept. 12, 13	Warwick Electronics Inc., Chicago, Ill.	Quality control for color TV set production.
Sept. 13	Wells Gardner Electronic Corp., Chicago, Ill.	Quality control for color TV set production.
Sept. 16	Hoffman Products Corporation	Quality control for color TV set production.
Sept. 17	American National Standards Institute, Subcommittee PH 6.5.	Attend meeting on dental x-ray standards.
Sept. 19	Hoffman Products Corporation	Quality control for color TV set production.
Sept. 20	Admiral Corp., Chicago, Ill	Quality control for color TV set production.
Sept. 23	Federal Communications Commission, Washington, D.C.	Discuss possibility of an agreement to allow BRH personnel to formally observe microwave oven testing at FCC labs. in Laurel, Md.
Sept. 25	American National Standards Institute, New York, N.Y.	Discuss radiation protection instrumentation.
Sept. 26, 27	Packard Bell Electronics, West Los Angeles, Calif.	Quality control for color TV set production.
Sept. 29	New Jersey State Health Department.	Cooperate in microwave oven survey and to retrieve data on used x-ray equipment.
Oct. 1	U.S. Coast Guard	Initiate agreement for surveying x-ray equipment.
Oct. 6	Electronic Industries Association	Discuss phrasing of proposed TV standard.
Oct. 7	RCA, Camden, N.J	Quality control for color TV set production.
Oct. 10	American Academy of Dental Radiology.	Participate in panel discussion on dental x-ray equipment standards.
Oct. 14–17	Aero Space and Flight Test Radio Coordinating Council, Dallas, Tex.	Present requirements of P.L. 90–602.
Oct. 15	Curtis Mathis Sales Co., Dallas, Tex.	Quality control for color TV set production.
Oct. 17	Philco-Ford Corp., Philadelphia, Pa.	Quality control for color TV set production.
Oct. 18	RCA, Camden, N.J	Quality control for color TV set production.
Oct. 21	Japanese Electronic Industries Association.	Discuss implications of P.L. 90–602 on imported electronic products.
Oct. 21, 24	General Electric, Syracuse, N.Y	Quality control for color TV set production.
Oct. 27	Underwriters Laboratory, Melville, N.Y.	Discuss microwave oven leakage and results of the U.L. life-testing program.
Oct. 28, 29	Westinghouse Corporation, Edison, N.J.	Quality control for color TV set production.
Oct. 31	American Medical Association	Discuss microwave radiation safety.
Oct. 31	Picker X-ray Corporation	Discuss development of x-ray performance standards.
Nov. 5	American College of Chiropractic Roentgenologists.	Participate in a workshop held in conjunction with the X-ray Department Directors and Clinic Directors of chiropractic colleges.

Date	Agency, Organization, or Industry	Pupose
Nov. 6	Food and Drug Administration	Obtain information on diathermy units currently in use in the United States.
Nov. 11	Sylvania Electronic Products, Inc., Batavia, N.Y.	Quality control for color TV set production.
Nov. 13	American National Standards Institute.	Discuss standards development.
Nov. 17, 18	General Electric Corporation, Milwaukee, Wisc.	Discuss development of experimental x-ray unit and performance standards relating to diagnostic x-ray equipment.
Nov. 17	Smithsonian Institution	Discuss a laser radiation exhibit.
Nov. 18	Ad Hoc Committee on Microwave Bioeffect Research.	Discuss microwave bioeffect research.
Nov. 18, 20	Motorola, Franklin Park, Ill	Quality control for color TV set production.
Nov. 20	Television Manufacturers of America.	Quality control for color TV set production.
Nov. 25	Association of Home Appliance Manufacturers.	Discuss several selected topics of the proposed microwave oven standard.
Nov. 30	American College of Radiology, Commission on Technologists Affairs.	Discuss x-ray technician licensing.
Nov. 30	American Association of Physicists in Medicine-American College of Radiology—Joint Committee on Manpower Needs in Medical Physics.	Discuss manpower needs in medical physics.
Dec. 1	Nassau County Health Department, N.Y.	Participate in cooperative microwave oven survey.
Dec. 2	American College of Radiology, Committee on Manpower.	Discuss manpower requirements in radiology.
Dec. 4	Electronic Industries Association	Discuss recordkeeping under the newly proposed television standard.
Dec. 5	Olympic Radio and TV, Division of Lear-Siegler Inc., Long Island City, N.Y.	Quality control for color TV set production.
Dec. 8	Massachusetts Department of Health, Boston, Mass.	Participate in cooperative microwave oven survey.
Dec. 9–11	Heath Co., Benton Harbor, Mich	Quality control for color TV set production.
Dec. 11	American Dental Association—Council on Materials and Devices.	Present information in regard to dental radiological health activities of the Bureau.
Dec. 11	Electronic Industries Association and the Maryland State Department of Health.	Discuss TV repair shops survey.
Dec. 12	Department of Commerce	Discuss the role of the Department of Commerce in inspecting imported electronic products as provided in P.L. 90–602.

MEMBERSHIP OF TECHNICAL ELETRONIC PRODUCT RADIATION SAFETY STANDARDS COMMITTEE

The Committee was composed of:

Mr. Herbert M. Parker, Consultant to the Director, Battelle-Northwest, Richland, Wash. (Chairman)

Dr. Raymond T. Moore, Associate Commissioner, Environmental Control Administration, Rockville, Md. (Vice Chairman)

Mr. Donald L. Snow, Director, Office of Criteria and Standards, Bureau of Radiological Health, Rockville, Md. (Executive Secretary)

Dr. Mason C. Cox, President, Laser Industry Association, Southbridge, Mass.

Mr. Myron Domsitz, Chief, Electronic Technology Division, Institute for Applied Technology, National Bureau of Standards, Washington, D..C

Dr. Walter P. Dyke, President, Field Emission Corp., McMinnville, Ore.

Dr. John M. Heslep, Chief, Environmental Health and Consumer Protection Program, California State Department of Public Health, Berkeley, Calif.

Mr. Edward J. Legan, International Representative, International Brotherhood of Electrical Workers, Washington, D.C.

Dr. Edward B. Lewis, Professor of Biology, California Institute of Technology, Pasadena, Calif.

Dr. Robert D. Moreton, Assistant Director and Professor of Radiology, The University of Texas at Houston, M.D. Anderson Hospital and Tumor Institute, Houston, Tex.

Dr. Russell H. Morgan, Radiologist-in-Chief, Johns Hopkins Hospital, Baltimore, Md.

Dr. Roy A. Parker, Director, Division of Radiation Control, Louisiana Board of Nuclear Energy, Baton Rouge, La.

Mr. Lester R. Rogers, Director, Division of Radiation Protection Standards, U.S. Atomic Energy Commission, Washington, D.C.

Mr. Thomas H. Rogers, Vice President and X-ray Product Line Manager, The Machlett Laboratories, Inc., Stamford, Conn.

Commander Charles F. Tedford, Radiation Safety Branch, Submarine Radiation Medicine Division, Navy Department, Washington, D.C.

Mr. Geoge M. Wilkening, Bell Telephone Laboratories, Murray Hill, N.J.

Mr. Harris O. Wood, Director of Engineering, Consumer Operations—Electronics, Philco-Ford Corporation, Philadelphia, Pa.

Attachment 1

Report to the Congress on Studies Conducted Pursuant to Section 357 of the Radiation Control for Health and Safety Act of 1968

Public Law 90-602

JANUARY 1, 1970
(Revised July 1, 1970)

BRH
bureau of radiological health

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Environmental Health Service

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REPORT ON STUDIES CONDUCTED PURSUANT TO SECTION 357 OF THE RADIATION CONTROL FOR HEALTH AND SAFETY ACT OF 1968

INTRODUCTION

The Radiation Control for Health and Safety Act of 1968, Public Law 90-602, (42 U.S.C. 263b et seq.) amends the Public Health Service Act (42 U.S.C. 201 et seq.) to provide for the protection of the public health from radiation emissions from electronic products. The Act provides for the establishment by the Secretary of Health, Education, and Welfare of an electronic product radiation control program including the development and administration of performance standards to control the emission of electronic product radiation from electronic products and the undertaking by public and private organizations of research and investigation into the effects and control of such radiation emissions.

Specifically, the electronic product radiation control program shall include the following:

(1) development and administration of performance standards for electronic products;

(2) planning, conducting, coordinating, and supporting research development, training, and operational activities to minimize the emission of and the exposure of people to, unnecessary electronic product radiation;

(3) maintaining liaison with and receiving information from other Federal and State departments and agencies with related interests, professional organizations, industry and labor associations, and other organizations on present and future potential electronic product radiation;

(4) study and evaluation of emissions of, and conditions of exposure to, electronic product radiation and intense magnetic fields;

(5) development, testing, and evaluation of the effectiveness of procedures and techniques for minimizing exposure to electronic product radiation; and

(6) consultation and liaison with the Secretary of Commerce, the Secretary of Defense, the Secretary of Labor, the Atomic Energy Commission, and other appropriate Federal departments and agencies on (A) techniques, equipment, and programs for testing and evaluating electronic product radiation and (B) the development of performance standards to control such radiation emissions.

The Bureau of Radiological Health within the Environmental Control Administration of the Consumer Protection and Environmental Health Service is carrying out the electronic product radiation control program including the development of performance standards; surveillance activities; research and development; technical assistance to States, public agencies, and other groups; technical training; criteria development; research grants; and public information and education. A comprehensive report on the administration of the Act is submitted annually to the Congress.

Section 357 of the Radiation Control for Health and Safety Act of 1968, Public Law 90-602, entitled "Studies by the Secretary," directs the Secretary to conduct the following studies and report to Congress on the results of such studies on or before January 1, 1970, and from time to time thereafter as he may find necessary, together with such recommendations for legislation as he may deem appropriate:

(1) A study of present State and Federal control of health hazards from electronic product radiation and other types of ionizing radiation, which study shall include, but not be limited to—

(A) control of health hazards from radioactive materials other than materials regulated under the Atomic Energy Act of 1954;

(B) any gaps and inconsistencies in present controls;

(C) the need for controlling the sale of certain used electronic products, particularly antiquated x-ray equipment, without upgrading such products to meet the standards for new products or separate standards for used products;

(D) measures to assure consistent and effective control of the aforementioned health hazards;

(E) measures to strengthen radiological health programs of State governments; and

(F) the feasibility of authorizing the Secretary to enter into arrangements with individual States or groups of States to define their respective functions and responsibilities for the control of electronic product radiation and other ionizing radiation;

(2) A study to determine the necessity for the development of standards for the use of nonmedical electronic products for commercial and industrial purposes; and

(3) A study of the development of practicable procedures for the detection and measurement of electronic product radiation which may be emitted from electronic products manufactured or imported prior to the effective date of any applicable standard established pursuant to this subpart.

This report is the first such report of the studies conducted under Section 357.

Within the Bureau of Radiological Health, eight individual projects were established to study and report on various aspects of radiation control related to the directives of Section 357. None of these studies explored the problems related to potential health hazards from radioactivity in the environment resulting from the operation of nuclear reactors, fuel reprocessing facilities, or the peaceful uses of nuclear explosives. This report is a summary of the significant findings and conclusions of the Section 357 studies. Details of each study will be available as indicated in Attachment 2.

The structure of this report generally follows the sequence of items found in Section 357. Response to subpart (1)(B), which asks for "any gaps and inconsistencies in present controls," is summarized on page 1–27. To more clearly relate such findings to the pertinent area of study, "gaps and inconsistencies in present controls" are presented within the appropriate sections of the report and marginal notations are provided to indicate applicability of this item.

SUMMARY

Although this entire report is intended as a summary of the detailed study reports, a brief summary of the general findings and conclusions is presented here.

Various facets of **State control of radiation health hazards** have been investigated, including legislation and regulations, compliance, manpower, funds, training, and instrumentation. Although 47 of 53 "States" (including Puerto Rico, the Virgin Islands, and the District of Columbia) have passed legislation to authorize the control of ionizing radiation, only 50 percent of these have adopted most of the provisions of the Council of State Governments' model regulations. Considerable variation was observed among State regulations. Only five States have specific authority to control one or more sources of nonionizing radiation, such as lasers and microwaves. Major inadequacies in a number of State programs include (1) lack of regulations or failure to update regulations to implement radiation control authority, (2) insufficient funds and personnel to conduct comprehensive control programs in the areas of ionizing and nonionizing radiation, (3) no provision to license, certify, or set qualifications for operators of x-ray machines used in the healing arts, and (4) lack of uniformity in the control of health hazards from the use of radium and accelerator-produced radionuclides including safety standards, inspection requirements, regulations, and enforcement.

Federal control has been examined from the aspects of control of health hazards to the general public based on statutory authority to control radiation and control of health hazards to Federal employees and the public from electronic products and certain radioactive materials used by the Federal Government. It is concluded that:

(1) Federal statutory authority and responsibility for the control of health hazards to the public from electronic product radiation and certain types of radioactive material is limited to specified occupational situations, radiation uses, locations, or types of radiation. No Federal agency has authority to control the health hazards to the public from the general use of certain radioactive materials, such as radium, which are not controlled by the Atomic Energy Commission. Many States, however, have such authority and conduct control programs.

(2) Although the Federal Government is a major user of electronic products and certain radioactive materials which may be potentially hazardous to employees and the general public, radiation control programs within the various agencies vary considerably, and range from inadequate to comprehensive and effective. Uniform standards, procedures, and guides are needed for use by the agencies.

(3) Federal specifications for purchase of equipment and re-

quirements for disposal of equipment do not always include considerations of safety to users or the public.

(4) While the safety and efficacy of radiopharmaceutical and radiobiological products are subject to Federal control, no other products or devices, either domestic or imported, containing radium or accelerator-produced radiouclides and sold in interstate commerce are required to meet Federal safety standards.

The need for controlling the **sale of certain used electronic products**, specifically secondhand x-ray machines, was evaluated from the viewpoint of manufacturers, dealers, and State radiological health program directors, and by analysis of State x-ray survey data on secondhand x-ray machines. Major conclusions are as follows:

(1) There is no need at this time for separate standards for secondhand x-ray equipment. Most secondhand equipment can be upgraded to meet existing recommended standards.

(2) Controls are needed to insure that secondhand x-ray equipment is not sold or transferred without being upgraded to meet standards for new products.

The study of the necessity for the development of **standards for the use of nonmedical electronic products** for commercial and industrial purposes was limited to industrial radiographic and fluoroscopic x-ray units, particle accelerators, and analytical x-ray equipment. From this study, it is concluded that:

In general there is a lack of State control in this area. Federal performance standards under the authority of P.L. 90–602 should provide much of the control needed for the safe use of particle accelerators, analytical x-ray equipment, and industrial x-ray equipment. Such equipment is designed to produce radiation and the hazard relates largely to conditions of use. Such standards must include instructions that control conditions of use which affect radiation safety, including location, facility design and shielding, safety interlocks, warning devices, and proper radiation safety procedures. Adequate training of operators, and a good radiation safety program including inspections and surveys, as well as certification of licensure of operators by State agencies can play an important role and provide the additional controls needed in the safe use of these types of electronic products.

The development of practicable **procedures for the detection and measurement of electronic product radiation** which may be emitted from electronic products manufactured or imported prior to the effective date of any applicable standard was studied resulting in the following conclusions:

(1) Practicable procedures are available for the identification and location of potentially hazardous electronic products manufactured or imported prior to the date of any applicable standard.

(2) Practicable procedures have been developed for measuring and evaluating certain types of electronic product radiation from particular types of products, but procedures, including instrumentation, need to be developed for many other types of electronic product radiation.

RECOMMENDATIONS

Detailed recommendations of "measures to assure consistent and effective control of the aforementioned health hazards" [sec. 357 (a)(1)(D)] and "measures to strengthen radiological health programs of State governments" [sec. 357 (a)(1)(E)] are presented in the corresponding sections of this report. In summary, the recommendations encompass the following points:

(1) Model legislation for State control of nonionizing radiation hazards should be developed by the Public Health Service in cooperation with the States. Initial steps have been taken in this regard.

(2) Model State regulations for the control of all radiation hazards should be revised as frequently as necessary to assure compatible and up-to-date coverage.

(3) In addition to P.L. 90–602 performance standards, guidance relative to operator qualifications and safety procedures for particle accelerators, analytical x-ray equipment, and industrial x-ray radiographic and fluoroscopic equipment should be developed by the Public Health Service in cooperation with the States.

(4) The Public Health Service should increase the number and scope of training courses for the control of nonionizing radiation hazards.

(5) States should be encouraged to control the sale of secondhand x-ray machines to assure that these devices meet the same standards as those applied to new products.

(6) Consideration should be given to authorizing a single Federal agency to promulgate rules and regulations to control all radiation sources in Federal installations, except radioactive materials subject to control of the Atomic Energy Commission.

(7) The licensure or certification by States, to minimum Federal standards, of users within their jurisdiction of radiation sources in the healing arts, not presently subject to control of the Atomic Energy Commission, should be vigorously promoted by the Public Health Service.

Authority to carry out most of these recommendations is already present within the Department of Health, Education, and Welfare. These recommendations are being examined in terms of existing resources and priorities, and action is being taken where possible.

MAGNITUDE OF POTENTIAL PUBLIC HEALTH PROBLEM FROM ELECTRONIC PRODUCT RADIATION

The public health significance of any particular source of radiation is related to a number of factors. These include (a) the number of devices that are in use, (b) the anticipated growth rate, (c) the population at risk (number and kind of user; that is, housewife, child, or industrial worker), (d) relative toxicity of radiation, and (e) length of exposure (that is, a 40-work week or continuous household use).

The toxicity or health significance of ionizing radiation has been the subject of intense study for a number of years. Health effects may be either somatic or genetic. Among more common somatic effects are the induction of neoplasms or cancers; however much remains to be learned concerning somatic and genetic effects of this kind of radiation at levels either present in the environment or allowable by established guidelines.

With regard to nonionizing radiation, much less is known. Specifically, with respect to microwaves, it has been assumed until recently that the principal cause of biological damage from such radiation was heat generation, with eye cataracts being the most common manifestation of excessive exposure. Some research indicates that exposures to nonionizing radiation may have effect upon the central nervous system and also produce genetic effects.

The public health significance of any particular source of radiation must consider the source in question in light of the totality of radiation sources of all types within the environment. The complexity of this problem of totality can be understood by considering:

(1) The use of electronic devices that are capable of producing radiation which is incidental to their use or which may emit radiaton by design. Such devices include but are not limited to:

a. devices used in the home, such as television receivers;

b. devices used in commerce and industry, such as lasers, microwave ovens, microwave communications and detection devices, and ultrasonic generators;

c. devices used in medicine for diagnosis and therapy; and

d. special devices used for educational purposes, in research, and for defense.

(2) The use of radioactive materials including:

a. naturally occurring radioactive elements, such as radium, used in:

1. watches and other dial faces,
2. medical devices,
3. industrial devices, and
4. other devices and products, such as educational products, electron tubes, fire detectors, and record player brushes.

b. materials made radioactive by particle accelerators, used largely for medical diagnosis and industrial purposes; and

c. licensed byproduct, source, and special nuclear material.

(3) The possible effect on the environment, and exposure to the population, of:

a. actual or potential discharge of radioactive substances from nuclear-fueled electronic power generating plants;

b. actual or potential discharge of radioactive materials from the operation of nuclear fuel reprocessing plants;

c. peaceful uses of nuclear explosives as in the Plowshare Program;

d. radioactive materials disposal activities; and

e. nonionizing radiation resulting from various types and sizes of communications and detection installations including lasers.

Not the least part of the difficulty in making accurate assessment of the magnitude of the public health significance of any particular source of radiation is the need for considering the simultaneous action of a number of separate radiation sources—as well as chemical and biological agents—which, together, could have a total health effect on an individual or population group greater than the sum of the individual effects. There is, too, the possibility of effects from radioactivity resulting from nuclear tests.

One must be mindful, when considering the public health significance of any single source of radiation, not only of possible accidental, radioactive material and radiation intrusion into man's environment, but of the sheer number of electronic devices and devices using radioactive materials.

Estimates of the number of selected electronic devices now in use in the United States are shown in the following table.

The following electronic product applications have public health interest also in light of their growth potential.

(1) Color TV—While 90 percent of American households have one or more television sets, about 35 percent presently have color television. Current production of color television is 5-million units per year. Control of radiation from color telvision sets is important inasmuch as it is anticipated virtually every person is a potential viewer.

(2) Microwave devices—Although currently low in number, the application and use of microwave devices are increasing rapidly in both homes and industry.

(3) Lasers—The total laser market—largely industrial—is expected to have a growth of over 130 percent by 1972.

(4) Medical electronics—The general medical electronics market is expected to increase. Although ultrasonic devices comprise a small fraction of the total medical equipment marketed, an anticipated rapid growth of the use of both diagnostic and therapeutic ultrasonic devices is indicated. The microwave and shortwave diathermy market is also expected to undergo rapid expansion.

(5) Communication electronics—The communication electronics market in general is expected to undergo substantial growth. Microwave relay, radar, and other navigational aids for both commercial and private use are expected to have a growth of almost 100 percent by 1972.

(6) X-ray apparatus—While the national inventory of x-ray apparatus for both medical and industrial uses is substantial, it does not appear to be increasing appreciably; however, the medi-

Estimates of Selected Electronic Products in use in United States of America
January 1970

Product	Estimated total number
X ray	
Dental	100,000
Medical	115,000
Industrial	15,000
Accelerators	1,200
Color Television (Households)	24,000,000
Electron Microscopes	500
Infrared Ovens (Commercial)	15,000
Microwave Ovens	
Commercial	45,000
Domestic	50,000
Microwave Heating (Industrial)	300
Microwave Dithermy Units	15,000
Microwave Communications Transmitters	66,000
Radar	
Stationary	5,500
Pleasure Boats	7,500
Transmitters	
Commercial AM	4,300
Commercial FM	2,200
Educational FM	400
Commercial TV	700
Educational TV	200
Amateur	300,000
Citizens'	3,000,000
Aviation Services	200,000
Industrial Services	1,700,000
Transportation Services	500,000
Marine Services	200,000
Public Safety Services	700,000
TV Translators and Boosters	2,200
Laser	
HeNe	10,000
Ruby	2,000
Nd Glass	1,000
CO_2	1,500
Argon	1,250
YAG	1,000
Ultrasonic	
Medical Diagnostic	3,000
Medical Therapeutic	3,000
Welders	Few Thousand
Cleaners	Tens of Thousands

cal use of x ray is increasing and is the source of largest manmade ionizing radiation exposure to the American public.

In quantitative terms, a brief review of three of the more commonly used electromagnetic devices illustrates from another vantage point the scope of the problem in evaluating the public health significance of any one source of radiation. Data on these three devices—radiofrequency microwave towers, standard broadcasting and television stations, and fixed radar installations—were derived from the Electromagnetic Compatibility Analysis Center computer operated by the Department of Defense.

There are 65,904 microwave towers, using about 386,054 separate frequencies, in use within the limits of continental United States. Each tower uses an average of 10.52 frequencies. The demand for better communications is resulting in an annual increase in the number of such towers of about 15 percent. (Other special purpose microwave facilities with space and defense applications are not included in these figures.)

There are 16,482 standard broadcast stations scattered across the Nation, including AM, FM, television, and educational transmitters.

There are 5,325 fixed radar installations used for tracking, identification, communications, and other operations readily accomplished by radar.

The means are not available for establishing and locating the number of airborne, waterborne, and other type mobile radar installations in operation during any given day of the year.

Such installations can contribute in some manner to individual and population group exposures to radiation and may have a significance in terms of man's total exposure which will require continuing research and evaluation.

SEC. 357(a)(1) A STUDY OF PRESENT STATE AND FEDERAL CONTROL OF HEALTH HAZARDS FROM ELECTRONIC PRODUCT RADIATION AND OTHER TYPES OF IONIZING RADIATION

Present State Control

This study was designed to primarily determine gaps to control programs rather than being oriented toward defining program strengths. The information which follows was obtained primarily from:

(1) An evaluation of the compatibility and uniformity of existing State regulations for the control of ionizing radiation. The 1966 amended version of the Council of State Governments' Suggested State Regulations for Control of Radiation was utilized as a model with which each State's regulations, in force on March 1, 1969, were compared.

(2) A questionnaire on selected aspects of State radiation control programs completed by each State and the information analyzed and evaluated.

The assurance of nationwide consistency in control programs is predicated upon the utilization of compatible regulations that reflect the most current information available and which incorporate changes and additions made in Federal regulations. To meet this need the Suggested State Regulations for Control of Radiation was developed and is periodically updated by the Atomic Energy Commission, the Public Health Service, and the Council of State Governments. Although an attempt was made to perform the evaluations as objectively as possible, it was sometimes necessary for the study group to subjectively determine the significance of deviations from the model by the individual States.

Certain facets of State control of ionizing radiation, such as the control of radium and accelerator-produced radionuclides, are reported in greater detail in the parts of this report devoted to those selected topics. Additional information on State programs may be found in the Report of State and Local Radiological Health Programs, Fiscal Year 1968.

Significant Findings

Legislation and Regulations: As of March 1, 1969, 47 of the 53 States (including Puerto Rico, the Virgin Islands, and the District of Columbia) had passed legislation to authorize the control of ionizing radiation. Since this time no change has occurred. As of December 31, 1969, only five States had obtained specific authority to control one or more sources of nonionizing radiation, such as lasers and microwaves. Several other States have nonionizing radiation legislation pending.

Gap or inconsistency

Utilization of model regulations by States is one means by which compatibility among State programs may be maintained. Fifty percent of the States have adopted most of the regulations as found in the Council of State Governments' suggested model. Considerable variation was observed among State regulations in providing specific control features similar to the Council of State Governments' suggested model; for example, while 23 States regulate the operators of industrial radiography devices, only eight of these States require training or any other qualifications for nonprofessional operators of medical x-ray machines. Four States require licensing or certification for operators of x-ray machines used in the healing arts based upon specific standards for training and upon examination for competency.

Compliance: For the States to conduct an effective radiation control program, they must locate sources of radiation, conduct surveys to determine if the sources and facilities conform to appropriate regulations or acceptable standards, have the user correct any deficiencies, and conduct followup surveys to verify corrections. Registration or licensing of radiation facilities is one of the more effective ways of locating sources; however, these practices vary from State to State.

Information is available from only 34 States for FY 1968 regarding compliance status of medical x-ray machines. The majority of medical machines in these States have been registered. Three of these States had less than 10 percent of their medical x-ray machines in compliance, while five had over 90 percent in compliance. Variations are also apparent in the programs of States that have conducted surveys or inspections of x-ray facilities; for example, while 25 States have conducted initial surveys of most of their medical x-ray facilities, only six

Gap or inconsistency

States have performed resurveys of 75–100 percent of the x-ray devices used by physicians. Twenty-seven States have surveyed 75–100 percent of their dental x-ray facilities, but only eight of these States have conducted a similar percentage of resurveys.

Manpower: Based upon the manpower guidelines developed for this study, 30 State radiation control programs have an insufficient number of personnel to conduct a minimum control program for medical x-ray machines alone. Virtually all lack personnel for controlling nonionizing sources of radiation.

Funds: State radiation control programs spent almost $7.3 million in FY 1969, only 2 percent of which was utilized on control of nonionizing electronic product radiation. Variations were noted in individual State expenditures for radiation control with one State spending over 10 cents per capita while two others spent less than 0.1 cent per capita for radiation control.

Training: Nearly all States have personnel who have completed short-term training courses in some aspect of radiation control. In addition, 54 of these persons possess advanced degrees in some aspect of radiological health. In terms of future training courses, all States reported a need for courses in nonionizing radiation protection for their program personnel; however, many States indicated they lacked sufficient funds for their personnel to attend out-of-State training courses at the present time.

Instrumentation: The States have adequate instrumentation for surveying all types of ionizing radiation except neutron and low-energy x-ray sources, such as x-rays from color TV. Few State radiological health programs have the necessary instruments to survey nonionizing radiation sources.

Gap or inconsistency

Conclusions

(1) Although 47 States have regulatory authority to control all sources of ionizing radiation not subject to the Atomic Energy Act of 1954, only one-half of them possess up-to-date regulations to implement this authority.

Gap or inconsistency

(2) A majority of the States have registered and inspected most of their x-ray facilities but few States have reinspected the facilities to assure compliance with their regulations.

Gap or inconsistency

(3) Although States have indicated and exhibited a willingness to assist the Federal Government in correcting specific radiation hazards, most States are not presently staffed to conduct control programs in nonionizing radiation, and they do not have sufficient numbers of personnel to conduct a comprehensive radiation control program in certain areas of ionizing radiation.

Gap or inconsistency

(4) Nationally, the States lack adequate funds to enable them to maintain comprehensive radiation control efforts.

(5) Generally, States do not have personnel trained in the nonionizing radiation field, such as lasers, microwaves, and ultrasonics.

Gap or inconsistency

(6) Although there is an intensified interest in obtaining necessary legislation, at the present time only three of 52 "States" require licensing or certification of operators of x-ray machines used in the healing arts. Only nine "States" require training or any other qualifications for these operators

Present Federal Control

This study of present Federal control of health hazards from radiation is limited to electronic product radiation and radioactive materials other than those regulated under the Atomic Energy Act of 1954. Two aspects of Federal control have been examined: (1) control of health hazards to the general public based on statutory authority to control radiation and (2) control of health hazards to Federal employees and the public from electronic products and radioactive materials used by the Federal Government. Thirty-three selected Federal departments and agencies, as shown in the following table, participated in the study. They provided information on various facets of radiation control, including statutory control authority, control programs and procedures, and estimates of the quantities of various types of electronic products and radioactive materials used by them.

Participating Federal Departments and Agencies

Department of State
Department of the Treasury
Department of the Army
Department of the Navy
Department of the Air Force
Department of Justice
Post Office Department
Department of the Interior
Department of Agriculture
Department of Commerce
Department of Labor
Department of Housing and Urban Development
Department of Transportation
Department of Health, Education, and Welfare
United States Atomic Energy Commission
Agency for International Development
Civil Aeronautics Board
District of Columbia Government
Federal Communications Commission
General Accounting Office
Interstate Commerce Commission
Library of Congress
National Aeronautics and Space Administration
Peace Corps
General Services Administration
Government Printing Office
Smithsonian Institution
Tennessee Valley Authority
Selective Service System
United States Arms Control and Disarmament Agency
Civil Service Commission
United States Information Agency
Veterans Administration

Significant Findings

Statutory Authority for Control of Health Hazards to the Public: Direct statutory authority or responsibility for control of health hazards to the general public or specific population groups from the types of radiation included in this study has been identified within the following agencies to the extent noted:

(1) Department of Transportation: Control of the transportation of hazardous materials including radioactive materials.

(2) Department of Labor: Control of radiation hazards to employees of certain Federal contractors (Walsh-Healey and McNamara-O'Hara Acts) and employees in certain occupations (Longshoremen and Harborworkers Act).

(3) Department of Health, Education, and Welfare: Electronic product radiation control program including the development and administration of performance standards to control the emission of electronic product radiation under P.L. 90-602. Also, responsibility for the safety of food processed by radiation, radiopharmaceuticals, and biological products containing radioactive material. Promulgates and enforces Drinking Water Standards for potable water used by carriers subject to the Federal Quarantine Regulations. Promulgates criteria for air quality.

(4) Department of the Interior: Control of health hazards from ionizing radiation in the mineral extractive and related industries, principally the control of radon daughters in uranium mining. Promulgates criteria for surface water quality.

(5) Government of the District of Columbia: Control of radiation health hazards limited to the District of Columbia.

Indirect Responsibility for Control of Health Hazards to the Public: Responsibility for indirect control of health hazards to the public or specific population groups from the types of radiation included in this study was noted for the following agencies:

(1) Atomic Energy Commission: Regulations controlling exposure to licensed radioactive materials take into account the exposures to ionizing radiation from unlicensed materials and electronic products.

(2) Federal Communications Commission: To the extent that radiofrequency devices are found, under Public Law 90–602, to represent a health hazard to the public, the Commission would take such findings into account in determining whether the public interest would be served by the granting of approvals for such devices.

(3) Interstate Commerce Commission: In considering the application of a motor carrier for operating rights, the Commission takes into account the applicant's record of compliance with safety regulations, including those governing the transportation of hazardous materials.

(4) Department of Health, Education, and Welfare: Through its responsibility for administration of the Medicare Program, the Department specifies requirements related to the safety of services provided under the Medicare Program, including x-ray services. Through its responsibilities under the Hill-Burton Act, the Department prescribes standards for hospital construction and equipment.

(5) General Services Administration: Issues the "Federal Property Management Regulations" which deal with the utilization, sale, abandonment, and destruction of personal property, including hazardous materials and electronic products.

The Federal Radiation Council, although not specifically included in this study of Federal agencies, prepares recommendations for the approval of the President for guidance of Federal agencies in their radiation protection activities. The Federal Radiation Council, however, does not have any direct radiation control authority. Twelve agencies indicated that regulations, standards, or directives, applicable to radiation control within the agency, have been issued, which in part control health hazards to the public.

Although five Federal agencies have direct statutory authority or responsibility for the control of health hazards to the general public from the types of radiation included in this study, and five agencies have some indirect responsibility, the control is limited. Authority is restricted to certain types of radiation, occupational situations, radiation uses, or locations. No Federal agency has authority to control the health hazards to the public from the general use of certain radioactive materials, such as radium, which are not controlled by the Atomic Energy Commission. Many States, however, have such authority and conduct control programs.

A number of Federal agencies, and in particular the Bureau of Radiological Health within DHEW and the Atomic Energy Commission, directly influence the control of radiation hazards to the public through continuing programs providing state assistance, research, surveillance, training and education, hazards analysis and review, and standards.

Radiation Sources Used By Federal Agencies: Twenty-seven departments or agencies furnished an estimated inventory of the electronic product radiation sources that are used by them; generally, these estimates did not include products used by their contractors. These inventories, though recognized to be incomplete, provide rough estimates of the extent and distribution of use of electronic products within the Federal Government. A total of more than 200,000 electronic products, including every major type, were reported by these 27 agencies. Also, a relatively large quantity of radioactive material not regulated under the Atomic Energy Act of 1954, was reported by these agencies. The use of radiation sources by the Federal Government is expected to increase.

Radiation Control Programs for Federal Employees: Although all Federal agencies are authorized to establish health service programs, including preventive programs, for their employees, and are required to develop and support organized safety programs to reduce accidents and injuries, encourage safe practices, and eliminate work hazards and risks, frequently preventive programs are not included. The major users of radiation sources within the Federal Government, however, have control activities and health services which usually provide effective measures for prevention of injury to Federal and contractor employees.

Sixteen agencies indicated that regulations, standards, or directives have been issued for the control of health hazards to agency personnel or contractors, and enforcement procedures are in effect. Fourteen agencies have control procedures other than regulations, standards, or directives.

Gap or inconsistency

The radiation control programs of the various Federal agencies vary considerably, ranging from only supervisory warnings to employees where a potential hazard is recognized to comprehensive, effective programs, including medical programs to detect adverse biological effects. Many agencies reported that technical assistance by qualified radiological health personnel is needed. Eight agencies reported that procurement of certain electronic products or radioactive materials is controlled, and seven control disposition of these items; generally, these controls are applicable only to ionizing radiation sources.

Ten agencies reported occurrences of overexposures of personnel to radiation of some kind. Most of these were identified as occasional exposure measurements by personal dosimeters, such as film badges, which exceeded the guide limits for ionizing radiation exposure. Acute burns from lasers, microwave generators, x-ray diffraction units, and ultraviolet light sources were reported, and the occurrence in miners of lung cancer attributed to chronic exposures to radon and radon daughters was also cited. Though 19 agencies reported they had over 5,000 electronic product sonic radiation sources, no injuries because of sonic exposures were reported; however the Bureau of Employees Compensation, Department of Labor, reports that 213 schedule awards, totaling $917,576, were granted to Federal employees during 1966 for loss of hearing. These occupationally related injuries may have been related, in part, to electronic product sonic sources.

Conclusions

(1) Federal statutory authority and responsibility for the control of health hazards to the public from electronic product radiation and certain types of radioactive material is not limited to one agency.

(2) The Federal Government is a major user of electronic products which may be potentially hazardous to employees and the general public.

(3) Radiation control programs within the various Federal agencies vary considerably, and range from inadequate to comprehensive and effective. Uniform standards, procedures, and guides are needed for use by the agencies.

Gap or inconsistency

(4) Technical assistance by qualified radiological health personnel is needed by many Federal agencies.

(5) Federal specifications for purchase of equipment and requirements for disposal of equipment do not always include considerations of safety to the users or the public.

Gap or inconsistency

SEC. 357(a)(1)(A) CONTROL OF HEALTH HAZARDS FROM RADIOACTIVE MATERIALS OTHER THAN MATERIALS REGULATED UNDER THE ATOMIC ENERGY ACT OF 1954

Certain radioactive materials, primarily radium and accelerator-produced radionuclides, are not always subject to the same kinds of safety controls that the Atomic Energy Commission exercises over other radioactive materials. State and Federal control of health hazards from these materials has been examined from the viewpoints of hazards, extent and magnitude of use, present State control, present Federal control, and gaps and inconsistencies in the present controls.

Significant Findings

Radium is one of the more radiotoxic materials and has had the longest and most widespread use of any radioactive material. Accelerator-produced radionuclides vary in their degree of hazard; although limited at present, applications of these materials, particularly in medicine and in biological and physical research, are expected to grow rapidly in the future. The long history of radium use with little or no control has presented difficulties in locating all radium and radium users and in securing user compliance with appropriate regulations.

Responses to a questionnaire sent to manufacturers, suppliers, and importers of radium sources and/or devices and accelerator-produced material indicated the scope of the problem. Cumulative sales of radium through 1968 were approximately 1,130 curies, with an additional amount of about 152 curies on lease during 1967–68. Of the respondents furnishing information on leak testing or other safety testing of prototype or production radium sources or devices, only one-half reported performing such tests routinely and some reported they never conduct these tests on the sources or devices being sold.

Data from four manufacturers or importers of radium activated self-luminous timepieces indicate their annual U.S. sales for 1968 to be 2,665,000 pieces domestically produced and 1,008,000 pieces imported, with a total radium content of about 1.3 curies. Cumulative sales of accelerator-produced radioactive materials amounted to over 26 curies through 1968, with estimated annual sales of over 41 curies by 1971.

An estimate of the total number of located radium facilities in the United States in 1968, based upon a sampling of State data, is 4,130 facilities with a total activity of 474 curies, exclusive of Federal installations and generally licensed or exempt radium sources and devices. This number of facilities is approximately 25–30 percent of the total number licensed for use of byproduct materials.

While 25 States have regulations that are compatible with the radiation protection provisions of the Council of State Governments' Suggested State Regulations for Control of Radiation, 11 States do not have regulations for control of radioactive materials not subject to the Atomic Energy Act of 1954.

Gap or inconsistency

State radium control programs vary widely in scope and effectiveness. Many States spend a considerable portion of their resources in the control of radioactive materials already under the control of the AEC. A survey of State programs for FY 1969 indicated that seven States had not made even an initial inspection, and 20 States had conducted no reinspections of radium facilities under their control. Nineteen States that had performed inspections of radium facilities in 1968 reported they found almost one-half of the facilities not in compliance with appropriate regulations and only 63 percent of these were brought into full compliance. It should be noted that radium used in Federal facilities is not subject to State licensing in most States.

No single Federal agency has the exclusive responsibility and authority to control health hazards from radium and accelerator-produced radionuclides used in Federal facilities. A number of agencies have radiation control programs of varying degrees of effectiveness but no uniform, consistent control program exists for all Federal agencies and departments. The four Federal agencies that exercise some regulatory control to limit public exposure from the use of non-AEC controlled radioactive materials are: the Department of Labor through the Walsh-Healey Public Contracts Act, the Department of Transportation through its transportation regulations, the Food and Drug Administration through its responsibility for approval of drugs containing any radioactive material, and the National Institutes of Health through its responsibility for assuring the quality and safety of biological products under its jurisdiction.

Conclusions

(1) Radium, one of the more radiotoxic materials, is widely used. At the present time, the public use of radium and accelerator-produced materials can only be regulated by the States.

(2) The adequacy of State control of radium varies considerably. There is a lack of uniformity in such control measures as safety standards, inspection requirements, regulations, and enforcement provisions.

Gap or inconsistency

(3) Radium continues to be used in luminous compounds, although other less hazardous substitutes are available.

(4) There is neither a Government-wide program to insure that the use of radium and accelerator-produced radionuclides in Federal facilities meets minimum safety standards, nor are there standards for the use of radium and accelerator-produced material. Each agency and sometimes each facility may independently establish its own control program to the extent it feels necessary.

Gap or inconsistency

(5) While the safety and efficacy of all radiopharmaceuticals and radiobiological products are subject to Federal control, no other products or devices, either domestic or imported, containing radium or accelerator-produced radionuclides and sold in interstate commerce are subject to Federal regulations.

Gap or inconsistency

SEC. 357(a)(1)(B) GAPS AND INCONSISTENCIES IN PRESENT CONTROLS

The principal gaps and inconsistencies that have been noted with respect to State and Federal radiation safety control programs are set forth below. All gaps and inconsistencies noted in the various studies made in connection with this report are identified by marginal notes.

Present State Control

(1) Although 47 States have regulatory authority to control all sources of ionizing radiation not subject to the Atomic Energy Act of 1954, only one-half possess updated regulations to implement such authority.

(2) Forty-eight States were without specific authority to control one or more sources of nonionizing radiation, such as lasers and microwaves, as of December 31, 1969. Eleven States do not have regulations for control of radioactive materials not subject to the Atomic Energy Act of 1954.

(3) A majority of States have registered and inspected most of their x-ray and radium facilities, but few States have reinspected the facilities to assure compliance with their regulations; for example, information is available from only 34 States for FY 1968 regarding compliance status of medical x-ray machines, and this information is based on incomplete registration of medical x-ray machines. Only five States showed 90 percent of their medical x-ray machines were in compliance; three States had less than 10 percent of their medical x-ray machines in compliance. Only a very small percentage of the States that conducted compliance surveys carried out resurveys to assure compliance.

(4) Most States are not presently staffed or equipped with suitable instrumentation to conduct control programs in nonionizing radiation.

(5) The States lack adequate funds to enable them to maintain comprehensive radiation control efforts ($7.3 million in FY 1969). The most pressing need is for funds to provide effective control of electronic product radiation hazards at the user's level.

Present Federal Control

(1) Although the Federal Government is a major user of electronic products that may be potentially hazardous, radiation control programs within various Federal agencies vary considerably. Controls range from only supervisory warnings to employees where a potential hazard is recognized to comprehensive, effective programs including medical, health, and safety services to detect and control adverse biological effects. Improved coordination, including uniform regulations, procedures, and guides for use by the agencies are needed.

(2) Federal specifications for the purchase of equipment and requirements for disposal of electronic equipment do not always include considerations of safety to the users or the public.

Radioactive Materials Other Than Materials Regulated Under the Atomic Energy Act of 1954

(1) The adequacy of State control of radium varies considerably. There is a lack of uniformity in such control measures as safety standards, inspection requirements, regulations, and enforcement provisions. Radium continues to be used in luminous compounds, although other less hazardous substitutes are available.

(2) There is neither a Government-wide program to insure that the use of radium and accelerator-produced radionuclides in Federal facilities meets minimum safety standards, nor are there standards for the use of radium and accelerator-produced material.

(3) While the safety and efficacy of all radiopharmaceuticals and radiobilogical products are subject to Federal control, no other products or devices, either domestic or imported, containing radium or accelerator-produced radionuclides and sold in interstate commerce are subject to Federal regulations.

Used Electronic Products

More stringent enforcement of existing State regulations is needed for control and upgrading of deficient secondhand x-ray equipment.

Nonmedical Electronic Products Used for Commercial and Industrial Purposes

In general, there is a lack of State control in this area. Federal performance standards under the authority of P.L. 90–602 should provide much of the control needed for the safe use of particle accelerators, analytical x-ray equipment, and industrial x-ray equipment. Such equipment is designed to produce radiation and the hazard relates largely to conditions of use. Such standards must include instructions that control conditions of use which affect radiation safety, including location, facility design and shielding, safety interlocks, warning devices, and proper radiation safety procedures. Adequate training of operators and a good radiation safety program including inspections and surveys, as well as certification or licensure of operators by State agencies, can play an important role and provide the additional controls needed in the safe use of these types of electronic products.

SEC. 357(a)(1)(C) NEED FOR CONTROLLING THE SALE OF CERTAIN USED ELECTRONIC PRODUCTS

Performance standards, promulgated pursuant to Public Law 90–602 to control the emission of electronic product radiation, are not applicable to products such as antiquated or secondhand x-ray equipment manufactured before the effective date of any such standard. A study has been conducted of the secondhand x-ray equipment market and the condition of such equipment to determine if there is a need for controlling the sale of this equipment without upgrading to meet the standards for new products or separate standards for used products. Data and opinions were obtained from trade associations, manufacturers, x-ray equipment dealers, and State and local radiological health program directors. X-ray protection survey data on secondhand x-ray machines in a sample of five States were analyzed and evaluated. It should be noted that the results of this study do not apply to all used electronic products.

Significant Findings

X-ray machine manufacturers and trade associations reported the following:

(1) They have no control over the sale of secondhand x-ray machines sold by their dealers.

(2) Secondhand x-ray machines that cannot be upgraded to meet new machine standards should not be resold.

(3) There should not be separate standards for secondhand x-ray machines.

Responses from 334 x-ray machine dealers in five States indicated the following:

(1) X-ray sales and service companies, and dental supply houses are the main sellers of secondhand x-ray equipment.

(2) Sales of secondhand x-ray machines have been on the decline for the past 5 years. During 1968, sales of secondhand x-ray machines made up approximately 19 percent of the total sales of the dealers responding.

(3) Major factors considered by dealers before resale of an x-ray machine are radiation safety, age, condition of the machine, and operability.

(4) The three more common deficiencies dealers find in secondhand x-ray machines are poor collimation, improper filtration, and inadequate tube shielding.

(5) Of the dealers responding, the majority felt that dealers should be required to upgrade secondhand machines, prior to resale, to meet the same standards applied to new equipment, machines not able to meet the standard should not be sold, and there should not be a separate standard for secondhand x-ray machines.

State radiological health program directors responded as follows:

(1) Most felt that existing requirements on vendors to notify State agencies of sales or transfers of x-ray equipment have not proved effective.

(2) All programs apply the same standards to old equipment that they apply to new equipment.

(3) The majority reported finding old x-ray machines that could not be upgraded to meet existing standards and that they prohibit the use of such equipment.

(4) The majority of the programs require private owners and dealers to upgrade their machines to meet applicable existing standards prior to selling or transferring the machine to a new owner.

(5) Most of the program directors feel there is no need for a separate standard for secondhand x-ray machines.

A questionnaire was mailed to owners of x-ray machines that were registered with five State x-ray control programs in 1965 and 1966 to ascertain if these machines had been purchased new or secondhand. A total of 765 x-ray machines were identified as having been purchased secondhand. Analysis of data from the questionnaire and State x-ray survey results for these identified x-ray machines indicated the following:

(1) Thirty percent of the machines registered in the participating States had been purchased secondhand, with the three major purchasers of secondhand x-ray machines being dentists, physicians, and chiropractors.

(2) Over one-half of the owners of secondhand x-ray machines bought them from either another practitioner or the widow of a practitioner.

(3) A review of State x-ray survey data indicated that a total of 595 deficiencies were found in the initial survey of the 765 identified secondhand x-ray machines. The three more frequently occurring deficiencies were insufficient filtration, excessive beam size, and short exposure-switch cords. There was no observable pattern in the occurrence of deficiencies by makes and types of machines.

(4) Secondhand x-ray machines purchased from practitioners had about 9 percent more deficiencies on initial survey than machines purchased from dealers.

(5) From the State x-ray survey results, only 10 percent of the initial survey deficiencies remained uncorrected as of June 15, 1969. Of the uncorrected deficiencies, 44 percent were those commonly found on old fluoroscopes.

Conclusions

(1) There is no need at this time for separate standards for secondhand x-ray equipment.

(2) The number and types of deficiencies likely to be found on old x-ray machines are such that most of the machines could be upgraded to meet existing recommended standards, although this may not be economically feasible.

(3) The principal sellers of used x-ray equipment are the members or widows of members of the healing arts.

(4) Present State requirements for notification by vendors to State agencies of the sale or transfer of x-ray machines are not effective.

SEC. 357(a)(1)(D) MEASURES TO ASSURE CONSISTENT AND EFFECTIVE CONTROL OF THE AFOREMENTIONED HEALTH HAZARDS

(1) The States need more funds and manpower to conduct effective, comprehensive and more frequent inspections of all types of radiation sources to assure compliance with regulations and standards designed to protect the public health and safety.

(2) Model legislation for the control of nonionizing radiation hazards by States is necessary. The Public Health Service, in cooperation with the States, should prepare the model legislation. Initial steps have been taken by the Public Health Service.

(3) More frequent regular revisions of model regulations for control of all radiation hazards are needed by States to assure compatible and up-to-date coverage. The Public Health Service should publish these model regulations in cooperation with the States and the U.S. Atomic Energy Commission.

(4) Model regulations and standards for the safe use of particle accelerators, analytical x-ray equipment and industrial radiographic and floroscopic equipment are needed. The Public Health Service in cooperation with the States should prepare and publish these models.

(5) Consideration should be given to authorizing a single Federal agency, such as the Public Health Service, to promulgate rules and regulations for radiation sources in all Federal installations except radioactive materials subject to control of the U.S. Atomic Energy Commission. This will provide all Federal employees with uniform and effective radiation protection.

(6) A continuing national inventory of electronic products is needed to identify the numbers and types of radiation sources with the greatest public health impact. The inventory will help establish priorities of public health problems that require immediate or long-term corrective actions. The inventory should be conducted by the Public Health Service with the cooperation of States.

(7) The Public Health Service should vigorously promote the licensure or certification of users of radiation sources in the healing arts. Licensure or certification should be uniformly applied at Federal and State levels. Full use should be made of model regulations to assure compatibility between States.

(8) The Public Health Service, in cooperation with States, should develop a model radiation source inspection data system to provide States with a uniform method of storing, retrieving and evaluating data from inspections of radiation sources for compliance with regulations.

(9) Uncontrolled release of potentially harmful radiation sources to the public via Federal surplus property channels should be avoided. Federal Property Management Regulations should be revised and enforced to assure that no such potentially hazardous material or device is released without adequate safeguards. The General Services Administration should consult regularly with the Public Health Service on release of such surplus property and obtain Public Health Service approval before such release.

(10) States should be encouraged to control the sale or transfer of secondhand x-ray machines to assure that these devices meet the same standards as those applied to new products.

SEC. 357(a)(1)(E) MEASURES TO STRENGTHEN RADIOLOGICAL HEALTH PROGRAMS OF STATE GOVERNMENTS

(1) More funds and manpower are needed by States for the control of radiation hazards at the users level.

(2) More Public Health Service work with State programs is needed to assist in program development, especially as related to electronic product radiation.

(3) The Public Health Service should increase the number and scope of training courses for the control of nonionizing radiation hazards and present more of these courses at regional locations and within individual States.

SEC. 357(a)(1)(F) THE FEASIBILITY OF AUTHORIZING THE SECRETARY TO ENTER INTO ARRANGEMENTS WITH STATES TO DEFINE THEIR RESPECTIVE FUNCTIONS AND RESPONSIBILITIES

In response to this need, a conference on Federal-State implementation of Public Law 90–602 was held with represenatives from State and local radiation control agencies, and representatives from the Federal Government.

Radiation Control Problems

The conference identified a number of constraints to State participation in the implementation of Public Law 90–602 and the control of radiation hazards:

(1) Lack of adequate funds for State and local agencies to control ionizing and nonionizing radiation sources.

(2) Insufficient manpower and instrumentation in many States to adequately deal with both ionizing and nonionizing radiation.

(3) Growing number of uses and types of radiation sources.

(4) Gaps and inconsistencies between various control agencies in regulations and priorities.

(5) Lack of sufficient coordination between State and Federal programs.

(6) Lack of adequate standards and regulations for nonionizing radiation sources.

(7) Insufficient involvement of State programs in development of standards and model regulations.

(8) Undue emphasis on some radiological problems at the expense of radiological problems of greater public health importance.

The workshop groups discussed these constraints and recommended methods and resources necessary to overcome them.

Recommendations

The conference workshops emphasized the importance of involving State and local radiological health programs in the implementation of Public Law 90–602 and the need for coordinating State, local, and Federal radiation control activities. The Conference of Radiation Control Program Directors, representing all State and local programs, was identified as the major organization with which Federal agencies should work to achieve coordination and action. The participants unanimously called for an annual meeting sponsored by the Bureau of Radiological Health, of State, local, and Federal radiation control programs, to plan and implement solutions to radiation control problems.

Workshop recommendations on specific problems are detailed in the proceedings of this conference. The highlights are summarized below:

Radiation Control Activities

(1) The first priority of a radiation control program should continue to be the reduction of unnecessary healing arts x-ray exposure.

(2) Radiation control programs should expand their scopes to encompass all forms of radiation other than mechanical vibration as specified in Public Law 90–602.

(3) All radioactive materials, whether Atomic Energy Commission "agreement" materials or not, should be regulated in the same manner by State and Federal agencies.

(4) Environmental surveillance activities of the Federal Government should be curtailed in favor of source-oriented flexible State-operated environmental monitoring programs, with all collected data made available by the Bureau of Radiological Health for general distribution.

(5) The Department of Health, Education, and Welfare should assume regulatory responsibility in Federal installations for radiation sources currently not subject to regulation by the U.S. Atomic Energy Commission.

Implementation of Public Law 90–602

(1) The Department of Health, Education, and Welfare should enter into agreements with qualified State radiation control programs for the conduct of inspections and compliance activities associated with the administration of Public Law 90–602.

(2) An ad hoc committee of State radiation control program directors should be established to advise the Department of Health, Education, and Welfare on the effective implementation of Public Law 90–602.

(3) Continuing committees should be established with representatio nfrom Federal, State, and local radiation control programs to further study and implement the specific recommendations of the various workshops.

(4) The Department of Health, Education, and Welfare, the Atomic Energy Commission, and other interested Federal agencies should continue to support and sponsor the Conference of Radiation Control Program Directors in an annual workshop.

Program Support

(1) The Department of Health, Education, and Welfare should expand its support of Federal, State, and local radiation control activities.

(2) The Department of Health, Education, and Welfare, and the Atomic Energy Commission should continue to expand their support of technical training activities in radiation control, including short-term and university-based educational programs.

Standards, Legislation and Regulations

(1) Federal, State, and local agencies should participate in the formulation of regulations, standards and model legislation.

(2) State radiation control programs should use model legislation and regulations to assure uniformity and compatibility among the various control programs.

(3) The Conference of Radiation Control Program Directors should request the National Council on Radiation Protection and Measurements (NCRP) to consider the problems of exposure to sources of nonionizing radiation.

SEC. 357(a)(2) A STUDY TO DETERMINE THE NECESSITY FOR THE DEVELOPMENT OF STANDARDS FOR THE USE OF NONMEDICAL ELECTRONIC PRODUCTS FOR COMMERCIAL AND INDUSTRIAL PURPOSES

This initial study was restricted to industrial radiographic and fluoroscopic x-ray units, particle accelerators, and analytical x-ray equipment in order to study in depth the potential and existing problems of these types of electronic products which have a long history of use. The study included a review of typical uses of these products, radiation hazards inherent to each product including the fundamental aspects of radiation safety which should be considered, existing guidance and controls for these products, estimates of numbers of units in use now and in the future, and a review of reported accidents involving radiation exposure from these products.

Significant Findings

The major nonmedical applications of accelerators are for industrial radiographic, activation analysis, radiation processing, and research. The radiation processing market alone, in terms of the value of the products processed is estimated to have been about $100 million in 1967 and is expected to grow at an annual rate of 25 percent. Of the estimated 1,200 accelerators in the United States, 15 percent are located in hospitals and medical centers, 26 percent in Federal laboratories, 29 percent in universities, and 30 percent in industries. Accelerators are designed to produce intense beams of radiation and hence are potentially hazardous to the operators and to others in the vicinity. Radiation safety procedures for accelerators have been described in the "Particle Accelerator Safety Manual" published by the Bureau of Radiological Health. Major radiation safety factors to be considered in the use of accelerators are proper shielding of primary and secondary radiation, control of induced radioactivity, interlocks to prevent operation when a hazardous condition exists, adequate warning signals to personnel, adequate training of personnel, and a good radiation safety program including surveys and inspections.

Analytical x-ray equipment is primarily used in laboratories for the analysis of the atomic or molecular composition of materials, although on-line industrial functions may also be performed with this type of equipment. Analytical x-ray devices have many industrial uses and the products involved include petroleum, chemicals, metals, ores, rubber, and electronics. These devices are designed to produce x-rays of relatively low energy but at high outputs and improper use can present a hazard to the operator and to others in the vicinity. There is estimated to be on the order of 5,000 analytical x-ray devices in the United States, and their use is predicted to increase in the future. Major radiation safety factors to be considered in the use of analytical x-ray equipment include proper shielding, interlocks, warning signals, adequate training of personnel, and a good radiation safety program.

Industrial radiographic and fluoroscopic equipment is used for the inspection of objects by the use of x rays, hence this equipment is designed to produce intense beams of x rays. This equipment operates over a wide range of voltages and may be stationary or mobile, used in an open room or in a shielded cabinet. There were estimated to be about 10,000 industrial x-ray units in the United States in 1968, of which only about 5,800 units were registered with State and local radiological health programs. By 1972, estimates indicate that there will be about 12,000 units in use. Since this equipment is designed to emit radiation, the hazard is directly related to the conditions of use. These conditions of use include location, facility design and shielding, warning signals, interlocks, proper radiation safety procedures, adequate training of the operator, and a good radiation safety program.

A review of reported accidents involving radiation exposure from these types of electronic products indicates that the majority of the accidental exposures resulted from negligent acts of the operator; that is, failure to follow good procedural or use practices. Other common causes of accidents were equipment failure and negligence on the part of the manufacturer. It is evident from the description of reported accidents that serious injuries may result from careless and accidental misuse of such equipment as particle accelerators, analytical x-ray devices, and industrial x-ray machines.

The adequacy of existing guidance and controls on these types of electronic products varies considerably. At the Federal level, apart from the provisions of P.L. 90–602, only one Federal regulation applies to this equipment when used by organizations outside of the Federal Government. This is the Department of Labor's radiation standard promulgated under the Walsh-Healey Public Contracts Act. It has limited application and provides only the basic standards for protection against radiation, with no specific guidance related to particle accelerators, analytical x-ray devices, or industrial x-ray machines.

Gap or inconsistency

Some States do exercise some form of regulation over these electronic products, but the form of regulation and degree of control vary considerably among the States. While most States possess general regulations for industrial x-ray facilities and operators, there are practically no such regulations for particle accelerators and analytical x-ray devices. Current control of such equipment appears to be too general and too inconsistent in light of the potential hazards of this equipment. Registration, licensing, certification, and training of x-ray operators are important factors in the safe use of this equipment. No State requires industrial or other nonmedical x-ray operators to be licensed. Only two States require industrial radiographers to be registered, two States require other nonmedical x-ray operators to be registered, and one State requires certification of industrial x-ray operators. Twenty-two States, however, require some form of x-ray training for industrial radiographers, and 14 States require certain x-ray training for other nonmedical x-ray operators.

In addition to the limited Federal and State guidance and control, some guidance has been provided by such organizations as the American National Standards Institute, the National Council on Radiation Protection and Measurements, and the International Commission on Radiological Protection. The guidance provided by these organizations, however, is in the form of recommended practices and procedures and does not have the status of an enforceable standard or regulation.

Guidance and information on radiation safety provided by the manufacturers of these types of electronic products to the purchaser ranges from none to comprehensive and adequate; in general, safe facility design, installation of safety systems, and safe use of the equipment is the responsibility of the purchaser.

Conclusions

In general, there is a lack of State control in this area. Federal performance standards under the authority of P.L. 90–602 should provide much of the control needed for the safe use of particle accelerators, analytical x-ray equipment, and industrial x-ray equipment. Such equipment is designed to produce radiation and the hazard relates largely to conditions of use which affect radiation safety including location, facility design and shielding, safety interlocks, warning devices, and proper radiation safety procedures. Adequate training of operators, and a good radiation safety program including inspections and surveys, as well as certification or licensure of operators by State agencies can play an important role and provide the additional controls needed in the safe use of these types of electronic products.

SEC. 357(a)(3) A STUDY OF THE DEVELOPMENT OF PRACTICABLE PROCEDURES FOR THE DETECTION AND MEASUREMENT OF ELECTRONIC PRODUCT RADIATION WHICH MAY BE EMITTED FROM ELECTRONIC PRODUCTS MANUFACTURED OR IMPORTED PRIOR TO THE EFFECTIVE DATE OF ANY APPLICABLE STANDARD ESTABLISHED PURSUANT TO THIS SUBPART

Practicable procedures have been developed for locating and evaluating electronic products which may be hazardous and which were manufactured or imported prior to the date of any applicable standard. This problem has two important phases: (1) detection and identification of a potentially hazardous product through intelligence, surveillance, and/or product testing and (2) evaluation of the extent of the problem by measurements of radiation emitted by the product and evaluation of the potential exposure to people through information on the use, distribution, and location of the product.

Significant Findings

Potentially hazardous electronic products have been identified through: (a) market research and literature reviews, (b) reports from Government agencies and industry associations, (c) questionnaires distributed to interested and appropriate organizations, such as State and local health agencies and professional societies, and (d) reports by State and local health agencies.

A preliminary analysis of this intelligence is evaluated by persons having expertise in the areas of biological effects of certain types of electronic product radiation and by persons familiar with the potential radiation emission of various types of electronic products.

When these activities have identified a particular electronic product as a potential health hazard to the public, it is then necessary to conduct survey and testing procedures. Examples of surveys of electronic products that have been conducted are: (1) surveys of microwave ovens in the home and in commercial establishments, (2) surveys of color television receivers in the home and at the places of manufacture, (3) inspection and surveys of medical and dental x-ray equipment, and (4) surveys of electronic products used for instructional purposes in secondary schools; in general, the surveys were conducted in cooperation with State or local health agencies and this proved to be a satisfactory arrangement. Visits to manufacturers of electronic products are made to evaluate (1) radiation emissions, (2) quality control procedures, and (3) measures to reduce radiation emission from their products. The procedures and techniques for conducting these types of surveys are described in several reports published by the Bureau of Radiological Health.

Appropriate instrumentation, methodology, and techniques for measuring radiation emissions from particular electronic products have been developed. This entails studies of the physical processes of electronic product radiation generation and emission, of the interaction of such radiation with physical systems that might be used for detection and measurement, and the development or purchase and calibration of such instrumentation. Assessment of instrumentation requirements includes consideration of the type of radiation involved, energy or wavelength of the radiation, time or spatial distribution of the radiation, and desired accuracy, precision, and sensitivity. An example of the development of an instrument to meet the needs for surveying a particular electronic product is the TV x-ray survey meter developed by the Bureau of Radiological Health and now available from commercial sources.

Conclusions

(1) Practicable procedures are available for the identification and location of potentially hazardous electronic products manufactured or imported prior to the date of any applicable standard.

(2) Practicable procedures have been developed for measuring and evaluating certain types of electronic product radiation from particular types of products, but procedures, including instrumentation, need to be developed for many other types of electronic product radiation.

(3) Market research and information from manufacturers, industry associations, Government agencies, and State and local health agencies are useful in the identification and location of potentially hazardous electronic products.

(4) Provision of suitable instrumentation for measuring radiation emissions from electronic products is a very necessary part in the planning and conduct of surveys.

DISSENT FROM THESE FINDINGS AND RECOMMENDATIONS

In accordance with Section 357 (c), P.L. 90–602, letters of dissent from the findings and recommendations of the Secretary were received from the following and are available for review:

(1) Department of the Air Force—Letter dated January 21, 1970, from Gerrit L. Hekhuis, Colonel, USAF, MC, Deputy Director of Professional Services, Office of the Surgeon General, to Robertson J. Augustine, Ph.D., Bureau of Radiological Health, U.S. Public Health Service, DHEW.

(2) Texas State Department of Health—Letter dated January 20, 1970, from Charles R. Barden, P.E., Director, Division of Occupational Health and Radiation Control, to James W. Miller, D.D.S., Acting Director, Office of Regional Operations, Bureau of Radiological Health, DHEW.

(3) Department of Defense—Letter dated January 27, 1970, from David Packard, Deputy Secretary of Defense to Robert H. Finch, Secretary of Health, Education, and Welfare.

ATTACHMENT 2

LIST OF BUREAU OF RADIOLOGICAL HEALTH DETAILED STUDY REPORTS PREPARED PURSUANT TO SECTION 357, PUBLIC LAW 90-602

The following detailed Bureau staff study reports were used as a basis for the Report on Studies Conducted Pursuant to Section 357, Public Law 90-602. These reports are being published in the Bureau of Radiological Health Technical Report Series and will be available from the National Technical Information Service, Springfield, Va. 22151.

1. Electronic Product Inventory Study.
2. An Evaluation of the Compatibility and Uniformity of State Regulations for Control of Radiation.
3. A Study of Selected Aspects of State Control of Radiation Hazards.
4. Present Federal Control of Health Hazards from Electronic Product Radiation and Other Types of Ionizing Radiation.
5. State and Federal Control of Health Hazards from Radioactive Materials Other than Materials Regulated Under the Atomic Energy Act of 1954.
6. A Study of the Need for Controlling the Sale of Antiquated X-ray Equipment.
7. Conference on Federal-State Implementation of Public Law 90-602 (Published as BRH/ORO 69-4, PB 189-655).
8. A Study to Determine the Necessity for the Development of Standards for the Use of Selected Nonmedical Electronic Products for Commercial and Industrial Purposes.